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THESIS

A CASE STUDY: ACQUISITION REFORM AND THE NEW V-22 OSPREY PROGRAM

by

Paul M. Riegert

March 1998

Thesis Advisor:
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Michael M. Boudreau
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This thesis provides background information on the once-cancelled V-22 program and acquisition reform and then examines the impact of the latter on the former. It analyzes the V-22 program using DoD's "ten guiding principles of acquisition reform" as a standard and concludes that acquisition reform is having mixed results on this Major Defense Acquisition Program.

Much is being accomplished with acquisition reform in the V-22 program. A transformation of the business process from the top down is enabling the program office and its prime contractors to optimize cost, schedule, and performance. Earned value management metrics are actively being incorporated into the program's risk management process. Concurrent contractor/Government testing and maintenance reduces test time required by 72 percent. Cross-functional IPTs, as the backbone of the program, are breaking down "stove pipes" and facilitating concurrent engineering. Successfully implementing initiatives like CAIV and CLS and focusing on overall cost of ownership are reducing the cost of the program from cradle to grave. Commercial products and processes, like the Allison AE-1107C engine and CATIA software, are providing high quality systems at market controlled prices. Commercial item acquisition and CLS are being used effectively to minimize life cycle costs. "Win-Win" contracting with industry is providing engine reliability that should improve with time and save 30 percent in support costs.

Much can be accomplished still. Realistic contingency funding should be included in fiscal budgets to eliminate the migration of funds from R&D and PROC to O&S. SPI should be altered to pass a proportion of any program-related savings back to the program office.

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**A CASE STUDY: ACQUISITION REFORM AND THE NEW
V-22 OSPREY PROGRAM**

Paul M. Riegert
Captain, United States Marine Corps
B.S., United States Naval Academy, 1989

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

**NAVAL POSTGRADUATE SCHOOL
March 1998**

This thesis provides background information on the once-cancelled V-22 program and acquisition reform and then examines the impact of the latter on the former. It analyzes the V-22 program using DoD's "ten guiding principles of acquisition reform" as a standard and concludes that acquisition reform is having mixed results on this Major Defense Acquisition Program.

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LIST OF ACRONYMS

A&I	Analysis & Integration
ACAT	Acquisition Category (I, II, III, IV)
ADM	Acquisition Decision Memorandum
AFSOC.....	Air Force Special Operations Command
APN.....	Appropriation Procurement Navy
APML	Assistant Program Manager Logistics
ARBG	Acquisition Reform Benchmarking Group
ASN(RD&A)	Assistant Secretary of the Navy (Research, Development & Acquisition)
ASE	Aircraft Survivability Equipment
ATF	Acquisition Task Force
BPR.....	Business Process Reengineering
CAIG.....	Cost Analysis Improvement Group
CAIV	Cost as An Independent Variable
CAD/CAM/CAE.....	Computer Aided Design/Manufacture/Engineering
CATIA	Computer Aided Three dimensional Interactive Application
CBD	Commerce Business Daily
CINC	Commander In Chief
CIO.....	Chief Information Officer
CLS	Contractor Logistic Support

CNO Chief of Naval Operations

CAN Center for Naval Analysis

COEA..... Cost & Operational Effectiveness Analysis

COL..... Colonel

CPAF Cost Plus Award Fee

CSAR..... Combat Search And Rescue

CSCSC Cost Schedule Control System Control Criteria

DACM..... Director of Acquisition Career Management

DARPA Defense Advanced Research Projects Agency

DAWIA..... Defense Acquisition Workforce Improvement Act

DCMC..... Defense Contract Management Command

DEPSECDEF Deputy Secretary of Defense

DMR Defense Management Review

DoD..... Department of Defense

DRB Defense Resources Board

DSB..... Defense Science Board

DT IIA..... Developmental Test, Phase II

DTC..... Design To Cost

EC/EDI..... Electronic Commerce/Electronic Data Interchange

EMD..... Engineering Manufacturing Development

ESMH Equivalent Specification Mission Hour

EVM(S).....	Earned Value Management (System)
FAA.....	Federal Aviation Administration
FACNET	Federal Acquisition Computer Network
FAR.....	Federal Acquisition Regulations
FARA.....	Federal Acquisition Reform Act
FASA	Federal Acquisition Streamlining Act
FFS.....	Full Flight Simulator
FOC.....	Full Operational Capability
FSI.....	Flight Safety International™
FSD	Full Scale Development
FY	Fiscal Year
FYDP	(Five & Future) Years Defense Plan
GAO.....	General Accounting Office
GFE	Government Furnished Equipment
HASC.....	House Armed Services Committee
HML.....	Hard Mobile Launcher
HMX	Marine Medium Transport Helicopter Project
IBR.....	Integrated Baseline Review
IDA	Institute for Defense Analysis
IDEF.....	Integrated DEFinition
IETM.....	Integrated Electronic Technical Manual

IERT.....	Independent Executive Review Team
ILSMT.....	Integrated Logistics Support Management Team
IOC.....	Initial Operational Capability
IPT.....	Integrated Product Team
IT.....	Information Technology
ITAR	International Traffic in Arms Regulations
JMVX.....	Joint Multi-Mission Vertical Aircraft (X-experimental/test)
JPO.....	Joint Program Office (Bell Boeing, Pax River))
JROC.....	Joint Requirement s Oversight council
JSOR	Joint Services Operational Requirements
JTA.....	Joint Technical Assessment
JVX	Joint Rotary Wing Development
LCF	Low Cycle Fatigue
LRIP	Low Rate Initial Production
LRT	Logistic Response Time
LTGEN	Lieutenant General
MAJGEN	Major General
MDAP	Major Defense Acquisition Program
MET	Maintenance Engineering Team
MILCON.....	Military Construction
MILPRF	Military Performance Specification

MILSPEC/STD.....	Military Specification/Standard
MLR.....	Medium Lift Replacement
MNS.....	Mission Need Statement
MOTT.....	Maintenance Operational Test Team
MOU.....	Memorandum Of Understanding
MVX.....	Multi-mission Vertical Aircraft
NASA.....	National Aeronautics and Space Administration
NAVAIR.....	Naval Air Systems Command
NBC.....	Nuclear, Biological, & Chemical
NPR.....	National Performance Review
NTE.....	Not To Exceed
O&M.....	Operations & Maintenance
O&S.....	Operations & Support
OPEVAL.....	Operational Evaluation
ORD.....	Operational Requirements Document
OSD.....	Office of the Secretary of Defense
O to D.....	Organizational to Depot two tier maintenance
PA&E.....	Programs, Analysis, & Evaluation
PCO.....	Primary Contracting Officer
PDM.....	Program Decision Memorandum
PDR.....	Preliminary Design Review

PEO (A)	Program Executive Officer for the V-22
PIC	Primary IPT Coordinator
PMA-275.....	V-22 Program Office, NAVAIR
POM.....	Program Objective Memorandum
PROC	Procurement funding
QDR.....	Quadrennial Defense Review
RADM.....	Rear Admiral
RCB	Risk Management Control Board
RDT&E.....	Research, Development, Test, and Evaluation
RFP	Request For Proposal
SAP	Simplified Acquisition Procedures
SAR.....	Search and Rescue
SAT.....	Simplified Acquisition Threshold
SCP	Shift to Commercial Practices
SECDEF.....	Secretary of Defense
SECNAV.....	Secretary of the Navy
SET	Systems Engineering Team
SOCOM	Special Operations Command
SOF	Special Operations Forces
SOW.....	Statement of Work
SPC	Statistical Process Control

SPEC	Specification
SPI	Single Process Initiative
SR/HC	Stress Rupture/Heat Corrosion
TDR/P	Technical Data Rights/package
TEMP	Test and Evaluation Master Plan
T for C	Termination for Convenience
TQM.....	Total Quality Management
USAF	United States Air Force
USDA.....	Under Secretary of Defense for Acquisition
USD (A&T)	Under Secretary of Defense (Acquisition and Technology)
USD(R&E).....	Under Secretary of Defense (Research and Engineering)
USMC	United States Marine Corps
USN.....	United States Navy
VMAT	Vertical Assault Medium Transport
VSTOL.....	Vertical Short Take Off and Landing
VSTOVL.....	Vertical Short Take Off and Vertical Landing
VTOL	Vertical Take Off and Landing

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I. INTRODUCTION

A. AREA OF RESEARCH

The nation's procurement process has evolved over the years to the present system structured under acquisition reform initiatives. The purpose of this research paper is to determine the degree of positive or negative impact acquisition reform has had on a Major Defense Acquisition Program (MDAP) that has evolved with the process and to make recommendations based on the lessons learned.

B. RESEARCH QUESTIONS

1. Primary Research Question

What are the effects of acquisition reform on PMA-275, the Bell Boeing Tiltrotor Team, and Allison in the execution and delivery of the V-22 Osprey?

2. Secondary Research Questions

- a. What are the background and history of the V-22 Osprey Program?
- b. What are the history and principles of acquisition reform and why are they important?
- c. How have PMA-275 and the contractor teams applied acquisition reform to the V-22 Osprey program?
- d. How are the effects of acquisition reform measured in the Osprey program?

- e. What are the future implications of acquisition reform on the V-22 Osprey program?

C. DISCUSSION

The V-22 Osprey is currently a major defense acquisition program (MDAP) designed to fulfill the medium vertical lift requirements within the United States Marine Corps, U. S. Air Force and U.S. Navy in the early twenty-first century. It is a unique aircraft in that it incorporates tilt-rotor technology. This technology involves the rotating of rotors from a position similar to that of a helicopter to one similar to a turbo-prop airplane. Vertical lift is provided in the first rotor position and great speed is accomplished in the second. The services foresee a bright future for this cutting-edge technology in tomorrow's battlespace, but the V-22's past has been anything but bright.

Though the V-22 was exciting new technology and already through Milestones 0, I, and II of the acquisition process, the Osprey program was officially cancelled. This occurred during Fiscal Year (FY) 1990 budget disputes presided over by then Secretary of Defense Cheney. Only a slight amount of congressional "plus-up" support kept the program alive until the new administration restored it to the President's FY-1993 budget.

Along with the new administration came a "new way of doing business" in acquisition. Defense Secretary William Perry ushered a new approach to acquisition reform in March of 1994 as he set out to streamline the way the Department of Defense (DoD) did business. Innovative approaches to procurement and business relationships were encouraged in an effort to break the perceived status quo of overpriced and late

systems procurements. Acquisition reform was initiated with a four-page memorandum and later cemented with changes to the DoD Directive 5000.1 and 5000.2-R in March of 1996.

The V-22 Osprey was resuscitated and took life under the programs of acquisition reform. The new Osprey has greater performance, lighter weight and 20 percent less flyaway cost. It is now listed among the Navy's top "success stories" and was nominated for the David Packard Excellence in Acquisition Award.

D. SCOPE OF THE THESIS

This thesis is a case study that analyzes the acquisition reform initiatives in place at the program office (PMA-275) and with the Osprey's Prime Contractors. Though acquisition reform has broad application, each program is unique. The researcher identifies and explains the roles and responsibilities of those involved in this program and analyzes the degree to which reform is taking place. The extent of reform's impact on the V-22 program is gauged by DoD's ten principles of acquisition reform: 1) empower people to manage—not avoid risk, 2) operate in integrated product teams, 3) reduce cycle time by 50 percent, 4) reduce cost of ownership, 5) expand use of commercial products and processes, 6) use performance specifications and non-Government standards, 7) issue solicitations that reflect the qualities of a world class buyer, 8) procure goods and services with "best value" techniques, 9) test and inspect in the least obstructive manner to add value to the process or product, and 10) manage contracts for end results.

E. THE V-22 OSPREY

The V-22 Osprey is a tri-service aircraft that will utilize tiltrotor technology to accomplish missions more effectively than currently available aviation systems. It will provide self-deployable Marine Corps, Air force and Navy support worldwide. It meets or exceeds all of the following key military requirements:

U. S. Marine Corps:

- Combat assault, ship and land based
- 24 troop, 371 km (200nm) radius of action
- External cargo capacity

U. S. Special Operations Command (SOCOM):

- Special operations
- 18 troop insertion/extraction to 927 km (500nm) radius of action

U. S. Navy:

- Combat Search and Rescue (CSAR) to 890 km (480nm) radius of action
- Special Warfare team insertion/extraction
- Logistics supply to ships at sea [Ref. 19:p. 1-16]

What enables the V-22 to accomplish these missions? A brief discussion of the V-22 flight envelope and lift performance, unique wing and “twist capsule” structure, powerplant, aircraft survivability features, environmental control systems, avionics, and use of composite material technology will give the reader a solid appreciation for the aircraft.

The aircraft flight envelope and payload capacity are unique. The performance results of the V-22 listed in Figures 1.1 and 1.2 illustrate the ability of this vertical lift aircraft to transport sizeable payloads at speed and range comparable to a conventional turboprop transport.

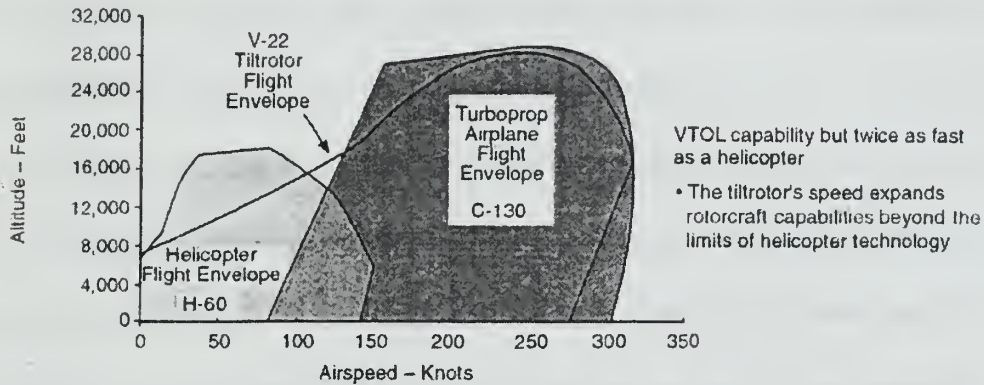


Figure 1.1, V-22 Flight Envelope [Ref. 19:p. 1-3]

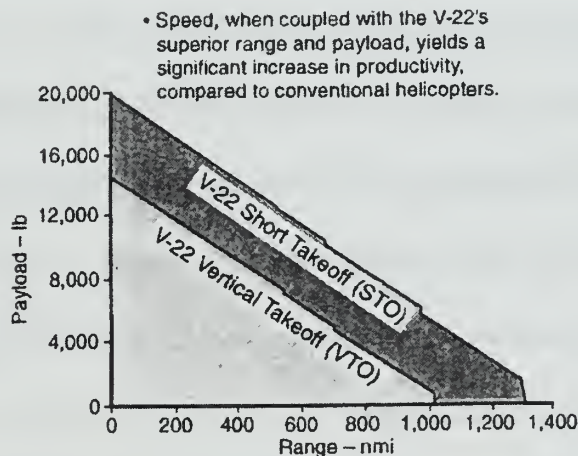


Figure 1.2, V-22 Payload and Range [Ref. 19:p. 1-4]

The V-22 Osprey's configuration is like no other aircraft. As depicted in Figure 1.3 at the end of this chapter, the aircraft is roughly 57 feet long, 84 feet wide and 22 feet high. The nacelles are positioned at the tip of each wing and contain the engine, gearbox, swashplates and 38-foot diameter proprotors. The nacelles can rotate at a rate of eight degrees per second from the 90-degree flight position through the 0-degree hover position to aft 7.5 degree for deceleration. This allows for full conversion performance in just over 10 seconds. The wings themselves rotate about a "twist capsule" within 90 seconds for shipboard handling and storage. Nearly 2,000 wires pass through this capsule enabling the aircraft's triply redundant "fly by wire" control system to perform.

The engines are Allison AE-1107C turboshafts that produce 6,150 horsepower each. These engines enable the aircraft to achieve a cruise speed of 275 knots and a maximum airspeed of 305 knots, or 363 miles per hour. The aircraft can lift external payloads up to 10,000 pounds or carry internal loads up to 300 pounds per square foot. Its maximum flight altitude is approximately 28,000 feet.

There are numerous survivability features in the V-22. The aircraft incorporates self-sealing fuel tanks. The proprotors, with lower end tip velocity, are inherently quieter than helicopter rotors. This enables tactical surprise. As well, the V-22 is equipped with crashworthy armored seats and armor plating surrounds aircraft vital areas.

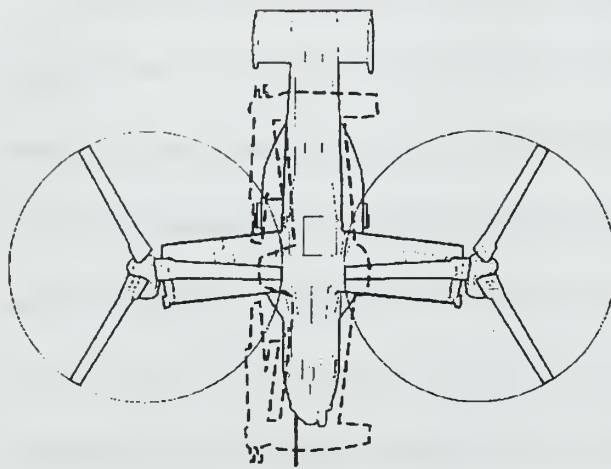
An effective environmental control system provides cabin pressurization and overpressurization for Nuclear Biological Chemical (NBC) protection and climate control

for the cockpit and avionics areas. Also, oxygen is generated for flight above 10,000 feet and the nitrogen byproduct is used to make inert empty spaces in the fuel sponsons.

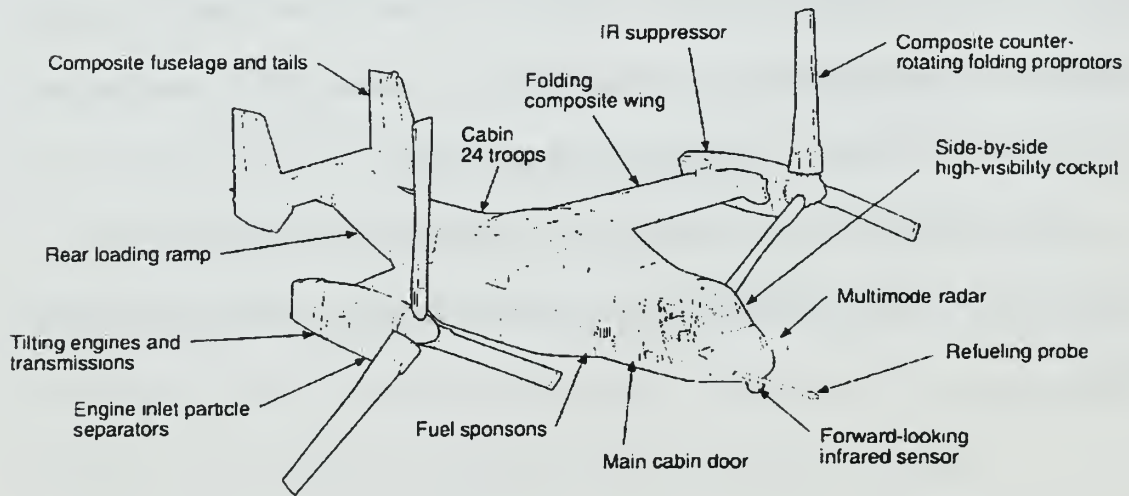
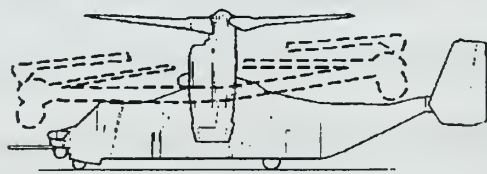
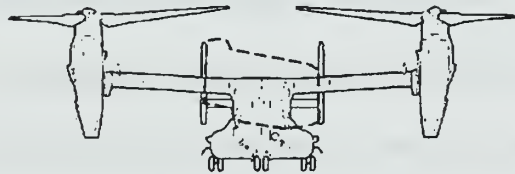
The cockpit is equipped with state-of-the-art avionics. All systems are integrated into a two-mission computer “glass cockpit” incorporating multi-functional displays for flight and navigation purposes and control display units for power plant, electrical and other information. Numerous electronic Aircraft Survivability Equipment (ASE) are incorporated, as well.

Multi-layer glass and composite laminate material technology delivers needed functional performance and great strength. One application is incorporated into the V-22's windscreen which is designed in several layers. One layer protects avionics from electromagnetic pulses. Another layer protects the screen from icing. A third layer is built to withstand a 31-pound birdstrike at 275 knots. Other sections of the aircraft, like the fuel sponsons, are composite laminates that offer great strength with little weight. All told, the airframe is 43 percent composite laminate materials.

With an abbreviated understanding of the missions and characteristics of the V-22, the history of battles fought thus far in its acquisition will be addressed in the next chapter.



Aircraft Characteristics	
Length	57 ft 4 in
Width	84 ft 7 in
Height	22 ft 1 in
Folded length	63 ft 0 in
Folded width	18 ft 5 in
Folded height	18 ft 1 in
Rotor diameter	38 ft 1 in
Power	2 x 6,150 shp
Empty weight	33,140 lb
Maximum VTO weight (sl/std)	52,870 lb
Short takeoff weight	57,000 lb
Self-deployment weight	60,500 lb
Maximum fuel capacity	2,037 gal
Cabin length x width x height	290 in x 72 in x 72 in
Cabin provisions	21 troops or 12 litters
Rescue hoist capacity	600 lb
Cargo floor limit	300 psl
Cruise speed (3,000 ft/91.5°F)	275 kias
Maximum speed (15,000 ft/45°F)	305 kias



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Figure 1.3, V-22 Diagram [Ref.: 19:p. 1-6]

II. PROGRAM HISTORY

With the onset of what promises to be a turbulent twenty first century, the Navy, Marine Corps and Air Force have developed strategies that require the operational capabilities of a special aircraft, the V-22 Osprey. Combat search and rescue, over-the-horizon amphibious assault and long range clandestine infiltration and exfiltration require advanced vertical/ short take-off vertical landing (V/STOVL) tiltrotor technology. Though much of “Joint Vision 2010” strategy rests on the soon-to-arrive V-22, the aircraft and its decisive-edge were almost squandered numerous times by a system highly susceptible to budgetary and political shortsightedness.

This chapter examines the history of this Major Defense Acquisition Program (MDAP) to provide the reader with the program background and an insight into just how complex the acquisition arena can become. First discussed is the early development of tiltrotor technology. The recognition of a valid military requirement that could be satisfied by this technology and the establishment of the program is covered next. The third section covers the successful efforts to keep the program alive amidst the carnage of post Cold War budget cuts. The last section briefly covers the program’s development from 1992 to present.

As the history of the program unfolds in this chapter, the reader is encouraged to note the degree of funding instability. In a presentation to the Program Management Seminar at the Naval Postgraduate School, Mr. Dan Celesniak, Director of DoD

Acquisition Integration, stated that the largest hindrance to true reform in DoD is the funding instability inherent in the budget process. This case study conclusively demonstrates this point.

A. TILTROTOR TECHNOLOGY DEVELOPMENT

Though the helicopter achieved satisfactory vertical take-off and landing (VTOL) performance, engineers and inventors were not satisfied with the aircraft's limited range and speed. Useful as it was, the helicopter was only capable of certain speeds due to retreating rotor blade stall and other aerodynamic limitations. Vertical/Short Take off and Landing (V/STOL) options provided a possible area to explore.

As necessity is the mother of invention, the best and brightest around the world raced for the solution. The first conceptual tiltrotor design was the British Baynes Heliplane, patented in 1937. [Ref. 1:p. 108] However, it was never developed. Heinrich Foché then designed his Fa-269 as part of the German war effort. It too, was never developed. [Ref. 2:p.176-177] It was not until 1945 that development of a tiltrotor took place. Americans Robert Lichten and Mario Guerrieri developed their Transcendental Model 1-G under Air Force and Army sponsorship. Model 1-G's first flight was in July of 1954, and eventually, it was able to rotate its rotors 70 degrees forward of the horizontal and achieve airspeeds of 115 miles per hour. [Ref. 3:p.73]

The Bell XV-3 was built in 1955 for the Army and Air Force as a continuation of the 1-G tiltrotor concept for possible V/STOL observation and reconnaissance use. Bell had been designing possible tiltrotor aircraft concepts since the 1940's and this was the

first that they actually developed. Below are the words of one the pioneers of tiltrotor technology at Bell in the late 1940's.

Conceptually, this helicopter/airplane could go twice as far and go twice as fast as a comparable sized helicopter—on the same amount of fuel. It would have twin 3-bladed rotor systems mounted at the tips of each wing. In the helicopter mode the rotor blades would rotate in a horizontal plane. Then, during forward flight, the rotor hub would rotate in a vertical plane like an airplane propeller. [Ref. 4:p.1]

The Bell XV-3 was the first tiltrotor aircraft to transfer fully from vertical to horizontal flight. The XV-3 rotated its rotors 90 degrees for cruise flight on 17 December 1958. The aircraft continued demonstrating concept feasibility testing until 1966. It flew 270 flights and accumulated 125 flight hours. [Ref. 5:p. 1]

The tiltwing concept was also developed as an alternative for V/STOL missions. Back in 1956, Boeing began development of the world's first tiltwing aircraft. The VZ-2 made its maiden flight in 1958. [Ref. 15:p.1-24] The VZ-2 proved the tiltwing to be effective in the airplane mode but demonstrated prohibitive challenges in other areas. The chief problem with the tiltwing design was, and is, wing stall during conversion flight mode. Though physically possible, a safe transition (vertical to horizontal flight or vice versa) required flight within a very narrow envelope of propeller tilt angles. Additionally, the tiltwing proved to be inefficient in a hover and at low speeds. [Ref. 15:p.1-13]

The Bell XV-15 aircraft followed. It incorporated many of the lessons learned from the earlier V/STOL efforts and demonstrated the maturity of tiltrotor technology.

Bell was awarded a joint Army/NASA contract for the then Model 300 as a "proof of concept" technology demonstrator program. As extensive improvements took place during design, the aircraft was redesignated the Model 301 and later the XV-15. [Ref. 2:p.182] Two XV-15s were built. "Aircraft development, airworthiness testing, and the basic 'proof of concept' testing were completed in September 1979, and in October 1980 the Government took delivery of its first tiltrotor, aircraft (N703), for continued research testing." [Ref. 6:p.1]

Though successful, the initial XV-15 effort was conceived as a low cost "proof-of-concept" development program. This philosophy stymied any real improvement to baseline systems designs and capabilities, "with changes permitted only if flight safety were an issue." [Ref. 4:p. 1] Any real improvement to the tiltrotor would require a serious interest by stakeholders in the acquisition arena and an increased perception of need.

B. A PROGRAM IS BORN

The Honorable John Lehman, Jr., President Reagan's new Secretary of the Navy, witnessed the aircraft's first public demonstration at the famous Paris Air Show in June of 1981. He was keenly aware of his helicopters' inadequacy for long-range missions similar to the failed "Desert One" hostage rescue attempt. The Navy needed a fast, long-range vertical lift capability. The aging Navy and Marine Corps H-46 Sea Knight fleet was in need of replacement soon, and the superior capabilities of the XV-15 caught his

eye. [Ref. 7] Secretary Lehman, recognizing a growing need, catapulted the tiltrotor from “concept demonstrator” to possible “requirement filler.”

Secretary Lehman’s Navy was joined by the other services in documenting medium lift vertical take off and landing (VTOL) capability needs. After reviewing the FY-1983 Program Objectives Memorandums (POM’s), the Under Secretary of Defense for Research and Engineering (USD(R&E)) recommended a joint program be established to minimize redundant efforts. Positive feedback by the services was received in October of 1981. By December, the Joint Services Advanced Rotor Wing Development (JVX) concept was defined and given approval (via memo) by the Deputy Secretary of Defense with the Army as the executive service. [Ref. 8] Though no actual Joint Mission Need Statement (MNS) was ever drafted, the services took the memo as a Milestone 0 (MS 0) decision and proceeded into concept exploration accordingly. [Ref. 9]

The mission need for the individual services was documented numerous times prior to this MS 0 decision. Its first appearance was in 1969 in the Specific Operational Requirement 14-21T; Vertical Assault Medium Transport (VMAT) published by the Chief of Naval Operations (CNO). This document then evolved into the requirement for the Marine Medium Transport Helicopter (HXM) in 1974 and the Mission Element Need Statement for the Marine Vertical Assault Transport (V/HXM) in 1981. The Air Force also documented their need on 30 December 1981 with the "Special Operations Advanced Vertical Lift Aircraft," Tactical Air Forces Statement of Need 32-1382. [Ref. 8]

Actions by the Government did not take place in a vacuum. Bell Helicopter Textron recognized this as a strategic moment and initiated a program that was to prove invaluable. The “Guest Pilot” program was kicked off on Halloween of 1981 when Air Force veteran Senator Barry Goldwater (R-AZ) became the first public official to fly the XV-15 tiltrotor. Seeing is believing, and Senator Goldwater and other public officials who followed him soon became tiltrotor advocates. [Ref. 4]

The Services each reprogrammed \$1.5 million and met to establish joint mission requirements and to explore available potential technologies in February of 1982. [Ref. 10:p. 22] The Joint Services Operational Requirement (JSOR) group met and established ten mission areas that would later be accepted by the Service Secretaries in a Memorandum of Understanding (MOU) dated 4 June 1982. These mission requirements were eventually validated:

Marine

- Amphibious assault troop lift
- Amphibious assault external lift
- Land assault troops
- Land assault external lift

Navy

- Combat Search and Rescue
- Special warfare
- Fleet Logistics

Army Special Electronic Missions/Tactical Mobility

Air Force Long Range Special Operations Force (SOF)

All services, worldwide self deployability [Ref.23]

The Joint Technical Assessment (JTA) group looked into five possible technology alternatives. These ranged from minimal risk research and development to high-risk research and development technologies. These technologies included:

1. High Speed Conventional Helicopter
2. Compound Helicopter
3. Tiltrotor
4. Lift/Cruise Fan
5. Advancing Blade [Ref. 7]

The Government had clarified the need and the most probable technological solutions.

Bell and Boeing saw the opportunity to advance a tiltrotor solution for the services. On 7 June 1982, they announced a teaming arrangement for the JVX competition, and the following February this formidable duo's proposal would go unchallenged. In December of 1982, the JTA group concluded that the tiltrotor was indeed the best technology and the JSOR released similarly directed JVX suited operational requirements. The JVX Program was thus established and entered into Phase One. Not surprisingly, the Bell Boeing team was awarded the preliminary design contract on 25 April 1983. [Ref. 4]

The Army's leadership days in the program were numbered. Back in the fall of 1982, the Army requested that the program be delayed. The response from the other services resulted in the programs being adopted by the Navy. The Army financially supported the program's development from the backseat until May of 1983. Other

programs took priority and the Army pulled its RDT&E funding support. Though it could not afford to assist in RDT&E, it still planned on procuring 231 aircraft in FY-1993, which would ease production costs for the other services. [Ref. 11]

The Bell Boeing team submitted a JVX proposal for Full Scale Development (FSD) in July of 1984 with IOC of December 1991. The contract negotiations were long and difficult. Though there was quite a technological leap for the contractor, this FSD contract was not of the standard “Cost Plus” format used to allow contractors financial room to explore potentially risky technologies. At this time, the Army’s infamous “Sgt. York” air defense gun’s failures and a \$700.00 P3C Orion Toilet seat fed popular opinion that defense industries took unfair advantage of the military’s contracts [Ref.12:p. 255]. Secretary Lehman insisted on “Fixed Price” contracts for all aircraft procurement unless the program was extremely risky. A Pete Marwick, Mitchell, and Company analysis of Navy contractors concluded that Boeing and the other top contractors were collecting 400 percent more return on assets for Navy contracts than commercial business and Secretary Lehman was determined to stop “Uncle Sugar’s” handouts [Ref. 12:p. 248]. This shifted the risk back on the contractor, and as the pendulum had swung fully, gave Bell Boeing little to no room financially to explore. [Ref.12:p. 249]

The resultant contract was quite a challenge for Bell Boeing. The contract’s ceiling price was actually lower than both the Bell Boeing and Government estimates for development. The contract required Bell and Boeing to set up separate production sites and compete for eventual production. With this contract, the break-even point would

occur after nine years. [Ref. 13] Additionally, the aircraft price was not to exceed (NTE) \$16.6 million per aircraft on the first 240 produced and Bell Boeing would fund the production transition with no further Government assistance. [Ref. 14:p. 14] The FSD contract was awarded on 2 May 1986, a day after the program passed its DSARC Milestone II review, and included provisions for six FSD aircraft and an option for 12 pilot production aircraft.

According to Dick Spivey of Textron, the FSD contract's competition for production clause was counterproductive. Whereas Bell and Boeing were sharing information fully prior to the contract, distrust and paralysis after the contract slowed the development effort significantly. Had the technology been appropriately classified as somewhat risky and the production contract been sole source, the program would have been better served. [Ref. 18]

Nonetheless, Bell Boeing was confident that they would recover their investments in the long haul even if they exceeded the ceiling. In the unfunded time frame of the FSD contract negotiation, Bell Boeing continued to invest in the program extensively. Production capability was expanded and focused marketing continued. Major subcontracts were awarded and a countrywide demonstration of the aircraft's capabilities logged over 3,500 miles. [Ref. 7]

The XV-15 Tiltrotor had gained worldwide recognition during its Paris Air Show debut, and the V-22 now received attention from the United Kingdom, West Germany, Japan and the Federal Aviation Administration (FAA). After visiting the V-22 Plant in

Fort Worth, Texas, Japanese Minister of International Trade Hikaru Matsunaga stated “If you produce this aircraft, I guarantee you we will buy it; If you do not, I guarantee you we will build it [Ref. 15:p. 1].” Soon thereafter, Japanese Ishida Aerospace opened up a plant in Ft. Worth, Texas, to design and develop the TW-68; a civil tiltwing V/STOVL aircraft [Ref. 16:p.1]. The firm has since folded. In August of 1987, FAA Administrator T.A. McArter took part in the “Guest Pilot” program, and the FAA soon established a tiltrotor office and joined DoD in the V-22 development efforts in an effort to streamline the tiltrotor certification process. Clearly, the tiltrotor’s technology was revolutionary. With the world’s airport traffic problems, applications of military tiltrotor technology would surely benefit civil aviation. This would soon become a two-way street as the program encountered difficulties. The tiltrotor’s commercial appeal and fostered political support would prove to be essential. [Ref. 4]

With the end of the Reagan military buildup, the services tightened their purse strings. The President’s FY-1988/89 budget submitted on 20 January 1987 included funding for 913 V-22s. Broken down by service, the tally was: Marine Corps 552, Navy 50, Air Force 80 and Army 231. One year later, on 10 February 1988, the Army announced that it would no longer be able to procure its 231 V-22s. Shortly thereafter, on 28 February 1988, the Air Force Special Operations Command reduced its total requirement from 80 to 55. Mounting costs for the Army’s LHX program (Commanche) and Air Force’s F-22 were absorbed by the V-22 funds. This lowered production to 657 aircraft and increased cost per aircraft accordingly. Though the Army could purchase the

Osprey later on, the program would no longer have the Army's political clout or be able to claim itself as "fully joint" — serving all four Services. [Ref. 17]

Through the end of 1988 and into January 1989, debate at all levels centered on increased unit costs and the necessity of competition for production. As stated earlier, Bell Boeing would have to run the original 913 aircraft production line for nine years just to break even. In July, the Program Budget Decision (PBD) approved a sole source funding profile submitted by the Program Office but failed to delete the requirement for competition in production. In September, the Under Secretary of Defense for Acquisition (USDA) was directed by the Joint Conference Committee (Congress) to determine if competition was still appropriate. On 01 December 1988, Bell Boeing submitted a not to exceed (NTE) cost for the FSD contract's 12 production aircraft pilot program option reflecting an 18 percent increase in per-unit costs as a result of the lower quantities produced. This lot proposal was for co-production by Bell and Boeing and not competitive. On 14 June 1989, the DoD Inspector general issued a report that chastised the program's inability to assess correctly the tiltrotor technology risk and its associated costs for dual sourcing. [Ref. 20:p. 16] On 04 January 1989, Under Secretary of the Navy Garrett responded by directing that the procurement be competitive but charged an Independent Executive Review Team (IERT), chaired by RADM Vincent, to investigate options. The debate and instability had a cost. Two weeks later, the V-22 Program Manager, BGEN Blot, slipped the program one year due to conflicting guidance from the chain of command and unanticipated test delays. [Ref. 17:p. 2]

Bell Boeing continued to press on amidst the turmoil. The FSD option for 12 pilot aircraft was approved on 24 February 1989, and Bell Boeing geared up for long lead production. The first flight of FSD aircraft number one took place on 19 March and delivery of production aircraft was slated for 1992. Production lines would have to be set up and personnel trained. However, just as the program was ramping up, it got cut. [Ref. 17:p. 2]

C. THE FIGHT FOR SURVIVAL

On 12 April 1989 the Defense Resources Board (DRB) issued a tentative decision to cancel the program. Secretary of Defense Cheney was faced with the task of cutting \$10 billion from the original budget request in order to comply with Gramm-Rudman deficit ceilings for FY-1990. His Director of Programs Analysis and Evaluation (PA&E), Dr. Chu, had opposed the V-22 from its earliest days and released a report concluding that a mix of conventional helicopters would be \$9 billion less expensive than the new Osprey alternative. Looking for “bang for the buck,” Secretary Cheney favored strategic over conventional forces. As the V-22 had just slipped a year and was arguably over cost, it is no surprise that he cut the program. Secretary Cheney admired the capabilities of the Osprey, but it was just too expensive.

The Navy responded. The V-22 was the Navy and Marine Corps’ first acquisition priority (officially) at the time and the Navy was quick to reclaim the mark. (The A-12 was a black program at the time and was the Navy’s unofficial first priority.) However,

the Navy and Marine efforts had little immediate effect as the DRB decided to cancel the program the next day, 19 April 1989.

Congress had nurtured the program all along and the services, particularly the Marine Corps, let their displeasure be known to key powerbrokers in the legislative branch. The V-22 was produced in 45 of the 50 states. Secretary Cheney's decision robbed congressional districts of jobs and Congressmen of potential votes. A unanimous "Sense of the Senate" resolution was immediately passed supporting the restoration of the V-22 program [Ref. 17:p. 2]. The battle lines were drawn. The executive branch and OSD wanted to kill the program; the Services and Congress wanted to keep it alive.

The response from the President took less than a week. On 25 April, the FY-1990 Presidential Budget was forwarded to Congress. It recommended termination of the Osprey program and included zero funding for FY-1990 and out. [Ref. 17:p. 2]

Bell Boeing had invested a great deal of capital up front calculating that profit would come later down the production line. Three days after the President released his budget request, Bell Boeing announced that it would not be able to continue work on the V-22 after 5 May unless the Government obligated an additional \$130 million. However, when 5 May arrived, Bell Boeing conceded that it would continue to work at its own risk until 30 September.

Down but not out, Congress directed the Office of the Secretary of Defense (OSD) to conduct a Cost and Operational Effectiveness Analysis (COEA). The Institute for Defense Analysis (IDA) was contracted and forecasted that the results would be

available in December, 1989. The Office of the Secretary of Defense was further instructed by Congress to include the results in the next year's FY-1991 Presidential Budget. [Ref. 17:p. 3]

With the end of the fiscal year came the end of Bell Boeing's commitment to fund the program. On 2 October, PMA-275 announced it would fund the program incrementally with FY-1989 funds through the first quarter of FY-1990 or until the FY-1990 budget was signed. The FY-1990 budget took some time before it was finally signed, however.

The FY-1990 budget was continued for one and one half months until the budget was finally signed on 13 November. OSD had mandated that all official Congressional inquiries be routed through OSD back in June. However, unofficial channels were opened and the services and contractors were able to influence congressional decision-makers. The showdown came in the House Armed Services Committee (HASC). Its chairman, Representative Les Aspin (D-WI), let the committee vote on all amendments as a package and then offered the Secretary of Defense's budget as an alternative. Secretary Cheney's budget needed a majority to be accepted but the vote resulted in a 16-16 tie with the congressional version approved. The new budget authorized \$255 million for V-22 Research, Development, Test and Evaluation (RDT&E), release of FY-1989 Appropriations Procurement Navy (APN) funds for long lead production development, and postponed the production funding decision until after the IDA study results were released. [Ref. 17:p. 3]

Bell Boeing was not sure the IDA would produce an unbiased report on the V-22. The Director of IDA was Dr. Dean Simmons. Dr. Simmons had released a negative report on the Army's LHX program, leading Bell Boeing to believe he might be biased against the V-22, as well. As a result, Bell Boeing contracted with Lawrence Livermore Labs and the National Aeronautics and Space Administration (NASA) to conduct a separate independent analysis of the V-22. Using stochastic modeling and simulation, NASA would be able to war-game the options and determine the most effective alternative. Bell Boeing took a risk with this decision. A contract stipulation included NASA's right to publish the results, even if they were negative. [Ref. 18]

The FY-1990 budget gave drowning PMA-275 a breath of air. In reaction to the FY-1990 budget, PMA-275 modified the contract's Statement of Work (SOW) to focus on RDT&E and only those production items necessary should a production decision be made at a later date. Additionally, BGEN Blot received approval from the Secretary of the Navy to return the program's Acquisition Strategy to co-production. The austere funding did not warrant competition for production, again, should a production decision ever be made. [Ref. 17:p. 3]

OSD did not quickly relinquish the RDT&E funding authorized by the FY-1990 budget. On 24 November, nine days after the President signed the budget making it law and a day after Congress had adjourned for the holidays, OSD proposed impounding V-22 FY-1990 RDT&E funding. After a high level meeting 28 November 1990 between SECNAV, SECDEF, USDA, and DEPSECDEF, the FY-1990 RDT&E funds were finally

released. However, DEPSECDEF then directed PMA-275 to terminate for convenience (T for C) long lead production preparation. FY-1989 APN funding obligated by the FY-1990 budget for this purpose was deobligated and Bell Boeing was served a FSD contract termination notice. The recouped \$200 million was placed on hold by the Department of Defense Comptroller Sean O’Keefe. [Ref. 17:p. 4]

The repeated efforts by the administration to kill the program went beyond normal political boundaries. Pennsylvania Congressman Weldon’s view of the administration’s maneuver, as expressed in the 5 December issue of *Defense Daily*, demonstrates how ugly the fight got; “Secretary Cheney displayed the ultimate in arrogance by trying to administratively subvert the defense budget process while Congress was in recess.” [Ref. 21:p. 24] Even congressmen who had no clear interest in the program expressed concern for the administration’s apparent lack of regard for the previous year’s budget agreement. California Congressman Dellums stated, “In effect, the Department of Defense is exercising a line item veto of Congress’s intent, and that, as we all know, is against the law.” [Ref. 21:p. 27] The General Accounting office (GAO) later ruled against DoD’s conduct. The FSD contracts were already terminated, however, and what was done could not be “un-done.”

With the first week in February 1990 came the FY-1991 Presidential Budget. It assumed a negative conclusion from the IDA study, which had not been released, and allotted zero funding for the V-22. Congress had made it clear that a FY-1991 V-22 production decision would be based on the IDA study results. Moreover, the budget took

\$200 million Secretary Cheney recently recouped from the terminated long lead production preparation, and dispersed it to other DoD programs. [Ref. 19:p. 339]

On 21 February, the Tiltrotor Coalition organized to fight DoD's efforts to kill the program. On the steps of the Air and Space Museum in Washington, DC, the group outlined the past efforts of OSD to kill the program, and highlighted the many advantages tiltrotor technology offered America. Membership included congressmen and industrial leaders. Not allowed to be part of such a group, but there in spirit, were senior Marines. The day prior, Marine Aviator LTGEN Pittman, who had been on the aborted "Desert One" mission, stated that helicopter technology was too constrained and that tiltwing or tiltrotor technology "was the way to go." [Ref. 23:p. 3]

The long awaited IDA study provided mixed responses. Though the study was completed in April, DoD did not immediately release it, and in so doing created some distrust. Meanwhile, a BDM analysis concluded that though \$7 billion more expensive, the V-22 was tactically superior across the board. The Lawrence Livermore Labs study came to the same conclusion. When finally released on 29 June, the conclusion of the IDA study favored the V-22 alternative as well. The study analyzed both the helicopter and V-22 options in eight mission scenarios—four Marine, two Air Force and two Navy. Since the main detractor for the V-22 in the controversial PA&E study was cost, IDA analyzed the V-22 at the \$33 million 502 aircraft fleet level and at a helicopter option cost level of \$24 million with 356 aircraft. In both cases the V-22 was determined to be more effective. In some of the longer range missions, the advantages were drastic. [Ref. 22]

In hearings before the Senate appropriations Committee on 19 July of 1990, Dr. Chu and Dr. Simmons cordially debated the IDA study conclusions. Senator Inouye noted at the hearing, however, that, in his recollection of 20 years in the Senate, this was “the first time that the Office of the Secretary of Defense has come out with full force to attack the assumptions, the credibility, the results, and the recommendations of the IDA.” [Ref. 22:p. 57] Dr. Chu argued that the tactical assumptions were flawed. Marine doctrine did not allow for more than two sorties or high-speed external lift flight. Dr. Simmons agreed that assumptions alter results but even with all the assumptions changed to Dr. Chu’s view, the V-22 would still be superior. Dr. Chu’s earlier tactical assumptions about dual slinging external loads were considered “totally ridiculous” by then Commandant of the Marine Corps, General Gray. Nonetheless, Dr. Chu summed up his view about the helicopter option by stating, “Maybe they (helicopters) are going to cost more to operate, especially if you buy a lot more, but that is downstream.” Up front costs of possibly \$42 million per V-22 were too much for DoD to fund even if the life cycle costs were less expensive. [Ref. 22:p. 78]

An interesting comment during the hearings by Senator Bumpers proved to be an omen of things to come. In stressing the importance of the decision before the committee, he expressed that Saddam Hussein’s recent criticism of Kuwait’s oil sales may turn into a situation where we as a nation may indeed need the advanced technology provided by platforms like the V-22. Indeed, the IDA study highlighted the strength of

the V-22 in a Middle East scenario. Two weeks later Iraq invaded Kuwait. [Ref. 22:p. 66]

The program would continue under the restricted FSD funding throughout the rest of FY-1990. It completed DT-IIA with Government test pilots doing the flying. Three aircraft were now flying and the program prepared for V-22 shipboard evaluation in the winter.

With the new fiscal year came \$246 million for RDT&E and \$365 million APN. The RDT&E funds included the disputed \$200 million rolled over from the original FY-1989 APN funds. Desert Shield was underway as the program underwent shipboard testing aboard USS WASP with FSD aircraft Three and Four [Ref. 24]. With the austere funding and budget uncertainty, the Program Manager and ASN(RDA) agreed to delete the Acquisition Plan's requirement for an engine second source. [Ref. 17:p. 3]

The illusive \$200 million from FY-1989 continued to sit in the OSD Comptroller's "bank." Secretary Cheney proposed, once again, no new funding for the V-22 in the FY-1992 President's Budget. Congress responded by including specific direction for OSD in a Desert Storm "Dire Emergency" bill, passed 22 March and in its "plus up" of FY-1992 funding to \$790 million. The Office of the Secretary of defense was to obligate the still withheld \$200 million FY-1989 APN funds within 60 days of the supplemental. The FY-1992 funding was earmarked for development, manufacture and operational testing of three production representative V-22 aircraft to meet all of the previous JSOR requirements by 31 December 1996. The OSD released the \$200 million

in April 1992, and on 10 June 1992 the RDT&E funds were finally obligated. The \$790 million would be debated later.

The program could not enjoy the victory over the RDT&E funding for more than one day. On 11 June, FSD Aircraft Five crashed on its initial hover check in Wilmington, Delaware. The crew experienced insurmountable lateral control problems. The aircraft rolled left and the left proprotor and nacelle impacted the flight line. There were no fatalities. [Ref. 25:p. 462]

The mishap investigation carried out by Bell and the Navy concluded that there were no design failures in the V-22. Production personnel had incorrectly installed wiring. Mishaps, as accidents are called in the Navy and Marine Corps, always have a chain of causal events that lead up to the actual event. Aircraft Five had been stopped and started over the past three years numerous times due to the funding instability. With each stoppage cycle, production personnel turned over duties. One of these turnovers occurred during flight control wire installation. Though efforts were made to ensure proper turnover, the wiring of roll rate sensors for the primary flight controls was done incorrectly. Pilot roll rate input was miscalculated by the flight control sensors and Aircraft Five rolled left and impacted the flight line. [Ref. 26:p. 33]

The program recovered from the crash well. The week following the mishap, the stop work order on the sixth FSD aircraft was cancelled to make up for the loss of Aircraft Five. Aircraft Six was about 50 percent complete when budgetary concerns

forced its sabbatical. Test flights resumed after three months of down time used to inspect all aircraft critical items. [Ref. 17:p. 6]

The FY-1992 budget's direction for the use of the \$790 million caused some "enabling problems" for the program. The six-year FSD contract was complete and Congress wanted to see the results of the effort. Later Congress required a "FSD II" Acquisition Plan be delivered within 60 days that would map out how three newly funded production representative aircraft would be ready for OPEVAL on 31 December 1996. The "problem" was that the program was not mature enough to meet this timeline. This was "enabling" because it caused an eventual showdown to occur where Congress and OSD would work out a compromise—one which sounded a lot like later acquisition reform initiatives.

The V-22's inability to meet the JSOR requirements provided OSD an opportunity, once again, to impound appropriated V-22 funding. On 3 June, the GAO, once again, ruled that the OSD was guilty of rescission and that it had until 3 August to obligate the earmarked V-22 funds. OSD countered that it was illegal to obligate funds knowing full well that the purpose for the obligation could not be fulfilled.

On 20 July, disaster struck. Aircraft Four crashed into the Potomac River as it was on final approach to the Quantico airfield. Seven crewmen were killed. Bell and Navy investigators determined that the causal factor was pooled transmission fluid in the left engine nacelle. The fluid ignited as it leaked onto the engine during the nacelles' rotation from the horizontal to vertical positions. Power continued to the drive system

from the operating second engine until the heat from the engine fire burned through the connecting shaft. This caused the aircraft to roll, uncontrollably, into the river. As a result, Congress required mishap investigation reports be completed prior to FY-1993 budget authorization and appropriation. [Ref. 31:p. 299]

Two weeks later, and two days after the GAO deadline, Acting Secretary of the Navy Sean O'Keefe, was called before the Procurement and Military Nuclear Systems sub-committee and the Research and Development subcommittee of the House Armed Services Committee to defend his department's actions. In the following exchange, it is evident that the time and cost goals set by Congress for the three new aircraft were not achievable:

CHAIRMAN. It is the provisions then in the appropriations bill that are "engineeringly" unworkable, in particular the 1996 date; is that what you are saying? Is that the part that is unworkable?

MR. OKEEFE. The Project Manager and the engineers involved in the program suggest that the combination of three different events in the statute is what is the show-stopper. The first is the requirement for a production representative aircraft which they determine to require on the order of about a 44 month production timeframe. Second, there is a further requirement that it be tested by a certain date which can not be accomplished in that window. The third feature is that \$790 million will not get you that program. [Ref. 27:p. 6]

Congress, understandably, held any DoD representative suspect. It was the impression of those at the hearing that DoD was, again, trying to kill the program. Funds were not being obligated and Secretary O'Keefe justified his actions with a legal loophole.

After outlining the program problems, Secretary O’Keefe proposed an alternative “FSD II” [Ref. 27:p. 11]. Though Congress was understandably skeptical of Secretary O’Keefe’s motives, the program, as it stood, could not meet JSOR requirements. Secretary O’Keefe’s MLR “FSD II” phase included a radical new Request For Proposal (RFP). When asked by Congressman Dellums how this RFP would lower the program’s cost, Secretary O’Keefe responded:

In essence, this request for proposal is going to be one of the most painfully short ones ever released. It is going to say to the contractor, propose how many prototypes you think are necessary and at whatever amount you think is appropriate, knowing we have \$790 million in the bank now and an undetermined amount that Congress will decide... [Ref. 27:p. 10]

Two weeks after the congressional hearing, one of two Bell XV-15 tiltrotors crashed. Just four days after the mishap, the National Transportation Safety Board announced that the crash was due to a loose connecting rod bolt in the aircraft’s left nacelle. Without control of the connecting rods, control of proprotor angles was lost, causing the aircraft to crash. Since the XV-15 mishap was not due to tiltrotor design error, the program was virtually unaffected. [Ref. 30:p. 26]

D. HISTORY’S GREATEST MULLIGAN

Though Secretary O’Keefe was not thought of as a “pal of the program,” what may have been meant to terminate the program, eventually benefited it [Ref. 32]. As Frank Gaffney, Director of the Center For Security Policy, put it, "(Secretary Cheney)

ordered the Marines to change the requirement in such a way as to permit it to be satisfied by an existing or future helicopter design." [Ref. 33:p. 31] Because it lowered the cruise speed requirement from 250 to 180, lowered the self-deployment range from 2,100 miles to an unspecified amount, and increased the lift requirement from 8,300 pounds to 10,000 pounds, helicopters could possibly have gained an advantage. However, with the new MLR draft ORD, came a new cost reimbursable contract and favorable new conditions that opened up possibilities for innovative solutions. [Ref. 27:p. 9]

On 22 October, two weeks prior to national elections, the Navy terminated the V-22 FSD contract for the convenience of the Government (T for C). It then awarded a \$550 million undefinitized letter contract to Bell Boeing for Engineering, Manufacturing and Development (EMD) of four new V-22 derivative aircraft to meet the new MLR ORD requirements (later definitized to \$2.65 billion CPAF). Vice President Quail delivered the news to Boeing in Philadelphia in person [Ref. 7]. The Navy awarded \$19.6 million for eight advanced helicopter concept studies and another COEA. [Ref. 28:p. 3] This second chance for Bell Boeing was termed "history's greatest mulligan" by Ross Clark of Boeing Helicopter because it not only gave them another shot at the V-22, but gave Bell Boeing the leeway to decide just how their new mission should be met. [Ref. 29]

New manufacturing techniques, information systems and management tools were now available that were not available back in 1986, when the terminated FSD contract

was written. This new contract opened up the door to what is now called “acquisition reform,” but back in 1992, was just smart business.

Boeing had just designed the B-777 for United Airlines using many of these new advanced capabilities. The new cost plus award fee contract enabled Bell Boeing to take the risk of incorporating new management and manufacturing technologies so vital to the “triple 7’s” success and cut costs by 12 percent. Integrated Product Teams (IPTs) were used in development and production of the B-777. Computer aided design and manufacturing enabled Boeing to reduce notorious problems like “tolerance stack-up” and thus build quality into the aircraft instead of inspecting it in at the end of the production line. Manpower-extensive composite application was replaced by castings and tape-laying machines [Ref. 35:p. 9]. The development of the “triple 7” was so exacting that the first aircraft built was also the first aircraft to fly passengers for United. [Ref. 34:p. 4]

The planning for execution of the “New V-22” program jumped into gear with the new year. Secretary Deutche replaced Secretary Cheney as the Clinton administration came into the White House. The Program Executive Officer, PEO(A), reviewed the program 14 January 1993 and again 23 June 1993. Potential for high risk was found if the program was not able to solve contractor personnel and systems management problems, so PMA-275 set out to mitigate these risks in preparation for an upcoming DAB.

On 5 August 1993, the Defense Acquisition Board's Acquisition Decision Memorandum (ADM) issued the following five directives:

1. Formal DAB November 1993
2. Combine Marine and Air Force COEA
3. Prepare FYDP profiles of \$4, \$5,& \$6 Billion, with less than \$ 1 Billion pre-production year
4. Rebaseline the program
5. JROC review ORDs and provide recommendations [Ref. 17:p. 8]

These five directives were achieved, but not necessarily according to timeline. The formal DAB was postponed until 13 September 1994 to realign the V-22 program with new Marine maneuver warfare requirements. The combined COEA, once again, concluded that the new V-22 was more effective than the helicopter options. In December of 1994, Secretary Deutch approved the Future Years Defense Plan (FYDP) in Program Decision Memorandum IV. The program was re-baselined by 13 September of 1994. Both Marine and Air Force ORDs were validated by the JROC by December of 1994. [Ref. 17:p.p. 8,9]

The Department of Defense conducted a bottom-up review in September 1993 that further encouraged joint program acquisition. The Air Force requirement during the budget battles with Cheney had been secondary since 85 percent of the planned procurement was required by the Marine Corps. When the MLR program was devised, the Air Force was forced to draft an AFSOC specific "MVX" ORD. Two programs existed under two separate ORDs at PMA-275 and the program had to integrate their efforts. The ORD was validated by the JROC in December of 1993, but the Air Force was directed to join in with the ongoing Marine efforts and combine ORDs. [Ref. 36]

The Marine MLR ORD, thus transformed back to “pre-Cheney” requirements, and now included key performance parameters of 240(Threshold)-270(Objective) knots and self-deployability worldwide. The program was once again multi-service. [Ref. 33:p. 31]

In October of 1993, the DoD considered the V-22 as a possible acquisition reform “pilot program.” Many of the initiatives already in place were noted, but as Robert Holzer of Defense News reported at the time “because of its uncertain status, it may be less attractive than other candidates.” Mr. Holzer was correct. It was not selected. [Ref. 34:p. 4]

The 13 September 1993 Milestone II plus (MS II+) DAB results were released in the Acquisition Decision Memorandum of 10 February 1994. In this document, numerous key items were decided:

1. Navy was established as the lead service
2. Navy fund all RDT&E for CV-22
3. MV-22 (Marine) IOC, FY-01
4. CV-22 (Special Operations) IOC, FY-05
5. USAF funds MV common equipment for CV-22
6. CINCSOCOM funds mission unique equipment for CV-22
7. DSB recommendations to DAB
8. USN & CINCSOCOM propose CV-22 exit criteria
9. LRIP I long lead funds approved
10. DAB review prior to LRIP
11. ASR, APBA and TEMP complete by 1 May 1995 [Ref. 17:p. 9]

Two months later, the MVX and MLR ORDs were combined into the Joint Multi-mission Vertical Lift Aircraft JMVX ORD. This was approved by the JROC 04 April 1995.

In February of 1996, the program successfully past its LRIP DAB review. Authorization to produce four production representative aircraft for follow on testing was given. The first aircraft was due to Patuxent River Naval Air Station in early 1997.

Due to the \$1 billion cap per year for procurement set by the 1993 DAB ADM, aircraft production lot inefficiencies existed. However, the most recent Quadrennial Defense Review (QDR) successfully increased production rates to gain more efficient lot production. With the new production buy the cost per aircraft is at roughly \$32 million. The current plan will stretch out until 2014. Its production rate is 30 MV-22 per year (starting 2004) and 360 aircraft total for the Marine Corps, 50 for the Air Force and 48 for the Navy.

In March of 1997, the first of four EMD test aircraft was delivered to Patuxent River Naval Air Station. Though a bit behind schedule, all four were delivered by January of 1998. Operational pilots are currently receiving flight instruction in aircraft that they will later evaluate during Operational Evaluation (OPEVAL). Milestone III is set for December 2000.

Funding profiles for the program are now solid. In 1997, the program had \$1,322.4 million. FY-1998 budget authorizations "plussed up" the program's original LRIP purchase from five to seven and appropriated \$1,206.1 million [Ref. 37:p. 1]. Currently (March 1998) the program is budgeted \$1,069.8 million for 1999 [Ref. 38:p. 16].

E. SUMMARY

In this chapter, the researcher has provided a brief chronology of events in the program's rocky history. The four basic sections of this chapter have been 1) the tiltrotor technology development from the British and German designs prior to WWII to present, 2) the birth of the program at Milestone I, 3) the fight for the Program to stay alive, and 4) history's greatest mulligan, the "New V-22" program.

F. CONCLUSION

Next, Chapter III addresses acquisition reform. The background and evolution of acquisition reform initiatives over the years will be covered first. Next, the prominent themes of reform in today's acquisition arena are covered. Finally, the status of how current pilot programs are fairing under current initiatives are presented as a benchmark and stepping stone into Chapter IV, Acquisition Reform and the V-22.

III. ACQUISITION REFORM

*"Nothing is more difficult to carry out, nor more doubtful of success,
nor more dangerous to handle, than to initiate a new order of things."*

- Niccolo Machiavelli
(1469-1527)

A. INTRODUCTION

Weapons procurement inefficiency has haunted America for some time. So, too, have efforts to correct the process. The recent efforts toward "a new order" in acquisition seek to make the Department of Defense "the smartest, most responsive buyer of the best goods and services, that meet our warfighters' needs, at the best dollar value over the life of the product." [Ref. 39:p. 1] This noble goal has been shared by numerous other previous acquisition reform efforts. This chapter briefly traces the evolution of acquisition reform. It also describes the current proposed solution as reflected in DoD's "Guiding Principles" of acquisition reform. The chapter ends with a brief look at efforts to measure whether or not the "new order" in acquisition is producing favorable results.

B. ACQUISITION REFORM HISTORY

Many efforts at improving the manner in which America arms itself have taken place over the years--and for good reason. Recognized problems in procurement go as far back as our founding fathers. A 1992 GAO report recognized cost growth and schedule delays occurring as far back as 1794 in the procurement of six frigates that were to form the backbone of the Navy. After schedule delays and cost overruns, only three were actually delivered. Since then, the Government has grappled with efforts to acquire

major weapon systems effectively. This subchapter will briefly describe a handful of the many efforts. [Ref. 40:p. 18]

1. Plowshares To Swords

The first period of procurement is one in which no military industrial complex existed. Industry would change production from “plowshares to swords” with each national emergency, in response to the change in demand. Reform took place during each ramp-up in weapons procurement.

a) The Civil War

The Civil War provided the first real catalyst to form procurement policy. As necessity is the mother of invention, crisis is the mother of solution. Prior to the war, procurement procedures were simple. After Congress appropriated funds, the military’s purchasing agents would seek a local vendor’s business. Due to the great demand brought on by the war, these local vendors increased their prices dramatically. With recent communication technology developments like the telegraph, the Government was able to respond by actively soliciting other vendors from throughout the Union. This new policy of advertising, or solicitation, delivered lower prices for the Union’s war effort. [Ref. 41:p. 80]

After the Civil War, solicitation for the lowest bid became the focus of acquisition at the expense of schedule and performance. By 1884, procurement statutes stated that “the award in every case shall be made to the lowest responsible bidder for the best and most suitable article” [Ref. 41:p. 80]. The lowest bid was easily quantifiable but

the “responsible” and “most suitable” were subjective factors left to opinion. Opinion justification as to vendor “responsibility” and “suitability” took place by exception only and required Attorney General approval. Incentive, therefore, existed to award to the lowest bidder at the expense of schedule and performance. [Ref. 41:p. 180]

In 1893, the Dockery Commission was established to review federal administrative activities. Congressman Alexander M. Dockery and his team reported “widespread duplication of contracting functions and a failure to use standardized specifications.” It recommended a multiagency board be created to review all purchases. [Ref. 53:p. 65]

b) World War I

World War I provided a major opportunity for reform to take place. With the mobilization effort came the requirement for higher quality items at an expedited rate. The established procurement system of lengthy solicitations was incapable of meeting this requirement. In response, negotiation without solicitation was allowed to take place. The expedited process helped. Still not enough vendors responded, however, due to the risk in developing new products for a fixed price. As a solution, a “cost-plus percentage” contract replaced previous “fixed price” solicitations. Unfortunately, the cost plus percentage incentivized some unethical contractors to incur great “costs” and thus increase their “percentage.” The Government responded by creating a Federal War Industries Board in July of 1917 and by developing a new “cost plus fixed fee” contract. Chairman Bernard Baruch and the new War Industries Board limited new fixed fees to

“fair and just market prices” and allowed great degree of leeway for the two executive military departments. [Ref. 44:p. 98]

c) World War II

World War II provided the next opportunity for acquisition reform. The National Defense Authorization Act of 1940, Executive Order 9001, the Letter Contract, National Procurement Manual and renegotiation were all efforts to optimize cost, schedule and performance in preparation for the upcoming war. The 1940 National Defense Expediting Act set ground rules for America’s transition from plowshares to planes. It authorized awarding “cost plus fixed fee” to other than the lowest bidder. Also, it authorized providing advance payments up to 30 percent of the contract price and splitting contract awards between multiple vendors in order to incentivize and broaden the industrial capacity. President Roosevelt’s new Executive Order 9001 authorized quarterly review of contract revisions that, until this point, required resolicitation and a great deal of time. Assistant Secretary of War Patterson devised a Letter of Intent, later known as the Letter Contract, that incentivized contractors to start on contracts prior to understanding fully the “fine print” involved. Work continued while details were hashed out. He also centralized a national procurement manual, similar to today’s FAR, which streamlined and consolidated contract preparation and conformance. Because of the “cost plus” abuses, renegotiation of contracts was finally allowed to reestablish fair and reasonable prices.

During the war, the success of systems acquisition relied on a close relationship between industry and the military. Working together, this “arsenal of democracy” produced staggering statistics. In 1941, America increased its production of airplanes by more than 500 percent from 3,600 to 18,000 a year. By 1944, American industry increased its production rate to over 100,000 planes of the quality similar to F-4U Corsairs and P-51 Mustangs. [Ref. 45:p. 81]

2. The New Military Industrial Complex

With the onset of the Korean War, America became the guardian of democracy throughout the world. The post-war shift back to an isolated peace economy, as had occurred up until now in the nation’s history, could not happen. A new Cold War required that our weapons stay a step ahead of the communist war machine. This newly required military industrial complex set out, “cost plus” contracts in hand, to be, once again, the “arsenal for democracy.” [Ref. 45:p. 82]

Growing accomplishments in military technology rivaled the production accomplishments of World War II. The growing Soviet threat in 1945 required that a new strategic bomber fly “almost three times as far, . . .25 percent higher, . . .and deliver four times the payload” of a B-29. Within two years, the B-36 was produced. As the B-36 was delivered, the growing speed requirement drove the design for a jet bomber. By 1951, the first of 2,000 B-47s was delivered. The B-47 could cruise 250 percent faster than the B-36. One year later, the first of over 800 B-52s was delivered. A B-52 could fly 10,000 feet higher and carry four times the payload of a B-47. [Ref. 45:p. 82]

This military industrial might in 1947 seemed unstoppable and with it, the power and influence of the military industrial complex. National leaders questioned the influential role of this new powerbroker and initiated simultaneous efforts to support, yet also limit, the power of the military industrial complex. With the National Security Act of 1947's creation of the new civilian led National Military Establishment came questions as to its role in and management of the military industrial complex. President Eisenhower warned in his farewell speech that "the councils of Government . . . must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military industrial complex." [Ref. 45:p. 83]

a) Hoover Commission

In 1947, the Hoover Commission was tasked with reviewing the executive branch of Government and making recommendations as to how it might be better managed and organized. The commission's Eberstadt task force on the National Security Organization concluded that the new organization "neither worked well nor yielded maximum security for the defense dollar." Additionally, it noted that intense inter-service rivalry "hampered and confused" policy. The task force recommended greater authority be granted to the Secretary of Defense, that the military budget system be overhauled and that teamwork within the organization be improved. [Ref. 45:p. 59]

b) "375 Series"

Lessons were learned during the Korean War on how to manage the intricate pyramid of Government, contractor, subcontractor and supplier relationships

from concept formulation to eventual phase out. These lessons learned were applied to the design, development, manufacture, test and evaluation and support of a new missile program in the “375 series” of procurement regulations, published in the late 1950s by the Air Force Systems Command. Figure 3.1 illustrates the acquisition life cycle devised by the air Force Systems command "375 series" regulations.

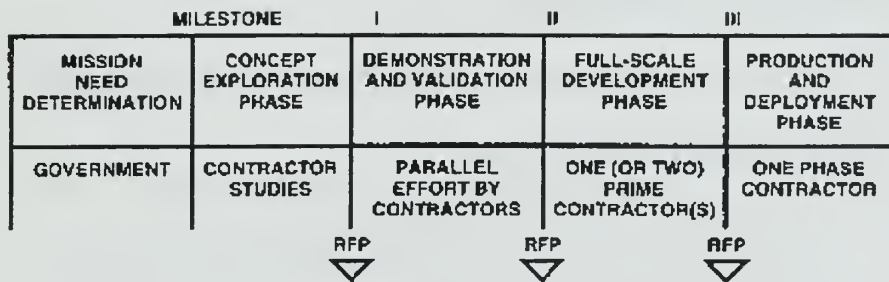


Figure 3.1, “375 Series” Acquisition Life Cycle [Ref. 45:p. 358]

c) FYDP and PPBS

The defense acquisition system underwent some major changes with the appointment of Robert S. McNamara to the position of Secretary of Defense (SECDEF) on 21 January 1961. A former business executive, the SECDEF set out to run DoD as he would a major company. Two reforms that affected the defense acquisition system were the Five Year Defense Plan (FYDP) and the Planning, Programming and Budget System (PPBS).

The FYDP grouped all defense resources according to the principal missions--regardless of service affiliation. The principal missions were further broken

down to elements. Inputs of manpower, defense systems and installations were converted to outputs of military functions through these ten major programs--listed by number:

1. Strategic Forces
2. General Purpose Forces
3. Intelligence and Communications
4. Airlift and Sealift
5. Ground and Reserve Forces
6. Research and Development
7. Central Supply and Maintenance
8. Training, Medical and Other General Personnel Activities
9. Administrative and Associated Activities
10. Support of Other Nations [Ref. 45:p. 349]

To make this system work, the SECDEF used another tool he had used in commercial business--the Planning, Programming and Budget System (PPBS). The national strategy (plan) was developed into an appropriate force structure (program) and then funded accordingly (budget). As national strategy changes with changing world events, PPBS is updated throughout the process accordingly. This PPBS system, with some adjustments, is the system still in use today. Figure 3.2 illustrates the ongoing nature of the process.

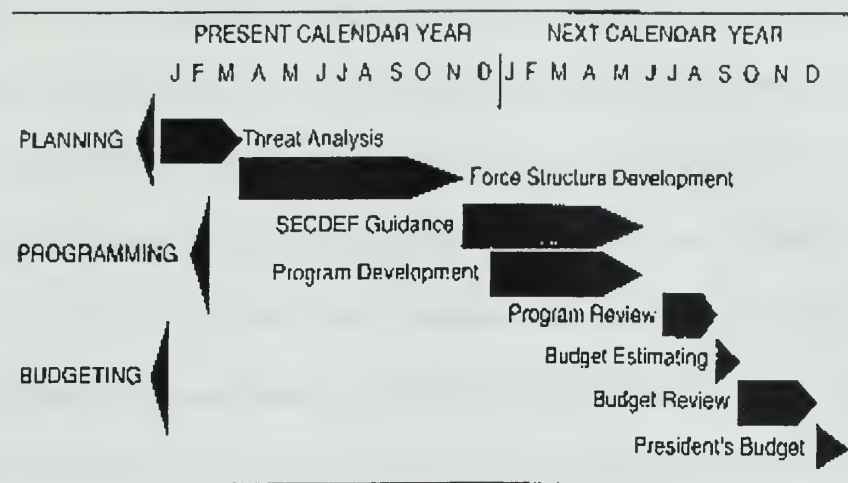


Figure 3.2, McNamara PPBS Process [Ref. 45:p. 350]

d) DoD Acquisition Improvement Program

By 1981, the acquisition process had become overburdened by oversight and regulation. In response, Deputy secretary of defense Frank C. Carlucci directed that 32 initiatives be taken to reduce over regulation and increase efficiency. The "DoD Acquisition Improvement Program" emphasized conducting long range planning, shortening the acquisition cycle, budgeting realistically, enhancing program stability and reducing cost. Authority shifted back to the program Manager to tailor his program innovatively within directives. [Ref. 45:p. 233]

e) The Packard Commission

On 15 July 1985, President Reagan established a Blue Ribbon Commission on Defense Management in response to unsettling stories about overpriced spare parts, test deficiencies and cost and schedule overruns. The President and Congress faced record budget deficits and apparent inefficiencies warranted investigation. A major

task of the commission was to “evaluate the defense acquisition system, to determine how it might be improved, and to recommend changes . . .” This mission was given to an Acquisition Task Force (ATF) directed by William J. Perry. [Ref. 51:p. 41]

The ATF concluded that further diagnosis of the “sick patient” would only result in “Band-Aid treatment of an inner illness”—much the way other reform initiatives had. Instead, the ATF investigated comparable Government and commercial systems in order to find successful exemplars on which to base reforms. This “search for excellence” led the ATF to American and Japanese companies employing Total Quality Management (TQM). [Ref. 51:p. 41]

The ATF identified six features that these successful companies had in common that could be applied to defense acquisition management. Clear command channels, stability, limited reporting requirements, communications with users, prototyping/testing and small, high-quality staffs typified most successful commercial programs. [Ref. 51:p. 50]

The ATF then derived a formula for action of nine steps by which defense acquisition could come to emulate the successful companies. The ATF believed that if these nine steps were followed, it would be possible to cut in half the ten to fifteen-year acquisition cycle. The ATF encouraged both the legislative and executive branches to set the example of teamwork that would be required to implement these steps.

(1) Streamline Acquisition Organization and Procedures. In order to clear up lines of responsibility and authority, the ATF recommended five actions.

First, create a level II appointment position in the Office of the Secretary of Defense responsible for the defense acquisition system with the title Under Secretary of Defense (Acquisition). Second, establish comparable senior top-level civilian appointee positions in the Departments of the Army, Navy and Air Force to serve as Service Acquisition Executives. Third, each Service Acquisition Executive should appoint program Executive Officers. Fourth, recodify the Federal procurement laws into a single, greatly simplified statute applicable Government-wide. Fifth, reduce the number of acquisition personnel substantially. [Ref. 51:p. 54]

(2) Use Technology to Reduce Cost. During the Cold War, technology was used to increase performance. The ATF recommended the use of technology to reduce cost. The use of technology to reduce cost had reduced the cost of computer products tenfold. The role of Defense Advanced Research Projects Agency (DARPA) should be expanded to prototype systems in order to determine cost and mission effectiveness during early development. [Ref. 51:p. 55]

(3) Balance Cost and Performance. The ATF found that DoD ignored many opportunities to adapt existing systems. Costly new systems were built to user requirement specifications that were not effectively challenged by the Defense Systems Acquisition Review Council. The developmental versus non-developmental decision should be made early on by a restructured Joint Requirements Management

Board co-chaired by the Under Secretary of Defense (Acquisition) and the Vice Chairman of the Joint Chiefs of Staff. [Ref. 51:p. 57]

(4) Stabilize Programs. The ATF recommended two ways to enhance program stability. First, “baselining” of major weapon systems should be initiated. A “baseline” agreement of support should be honored both up and down the chain. Second, the use of multi-year procurement for high-priority systems approved for Full Scale development should take place. The use of multi-year funding would include Congress into the baseline agreement. [Ref. 51:p. 59]

(5) Expand the Use of Commercial Products. Military specifications and over development of custom-made items failed to capitalize on the power of the free market system. The ATF recommended that DoD streamline military specifications and adopt commercial specifications and standards where possible. Additionally, DoD should take greater advantage of commercial “off-the-shelf” items. Once thought to be of inferior reliability, commercial items were now comparable or superior to DoD developed systems in some instances. Economies of scale and market forces would ensure cost control and relieve DoD of the administrative burden of cost verification. [Ref. 51:p. 60]

(6) Increase the Use of Competition. The ATF found that commercial procurement competition simultaneously pursued three objectives: attracting

the best qualified supplier, validating product quality and performance and obtaining the best price. Defense acquisition sought the lowest price but neglected the other two objectives. To fully capitalize on competition DoD should:

- Accept statistical process control techniques
- Solicit using functional, vice detail, design characteristics
- Maintain/use a quality supplier past performance list
- Treat price as one of several important factors
- Refocus the Competition in Contracting Act on quality of competition vice quantity of competition. [Ref. 51:p. 63]

(7) Clarify the Need For Technical Data Rights. The ATF found that defense acquisition rights-in-data regulations reduced incentives for American industry to do business with DoD. DoD should alter this policy as follows:

- If a product has been developed in private, DoD should not demand unlimited rights but directed licensing, if required.
- If a product has been developed by both Government and private funding, rights should be defined during negotiations according to the degree of private investment.
- If a product has been developed entirely with Government funds, the Government should consider permitting the rights to reside with the contractor

if not otherwise required for competition, publication and dissemination. [Ref. 50:p. 64]

(8) Enhance the Quality of Acquisition Personnel. The ATF found that the defense acquisition workforce was under-trained, underpaid and inexperienced. Action should be taken to attract more qualified personnel and to train and motivate current personnel. Specifically, recruitment and retention of personnel should correlate with pay, advancement and incentives based on performance similar to a program conducted at the Navy's China Lake Test Center.

[Ref. 51:p. 68]

(9) Improve the Capability for Industrial Mobilization. The ATF found that that there was no effective policy on industrial mobilization. Preparation time given in past wars and competition for Federal funding provided incentive for ad-hoc planning at best. The ATF found arsenals, shipyards, stockpiling and manufacturing equipment in immediate need of modernization. The President, with assistance from the National Security Council and DoD should establish a comprehensive and effective national industrial responsiveness policy capable of supporting the full spectrum of potential emergencies. Procurement practices in DoD should provide incentive for industry to modernize production processes. [Ref. 51:p. 71]

f) Defense Management Review (DMR)

The Packard Commission's report set down many of the reforms required in DoD. In June of 1989, Secretary of Defense Cheney set out to implement the recommendations of the Packard Commission with a Defense Management Review (DMR). Rather than plow the same ground as previous studies, it would build on their principles and outline a “pragmatic, workable set of recommended changes” to the acquisition laws. “Executive-legislative branch partnership was implicitly recognized by the Senate in approving the legislation that authorized the formation of the Acquisition Laws, otherwise known as the Section 800 Panel.” [Ref. 52:p. 33]

In January 1993, as the Commanders in Chief conducted their change of command, the panel submitted a 1,800 page report to Congress, culminating 16 months of effort. More than 600 acquisition statutes were reviewed and categorized as to whether they should be retained, repealed, amended or sustained. [Ref. 52:p. 33] Major recommendations included:

- Place Much stronger language in statutes toward procuring commercial/non-developmental items.
- Increase the small purchase threshold to \$100,000, as opposed to the current \$25,000
- Develop commercial terms and conditions

- Establish greater controls over the Department of energy/Environmental Protection Agency contracts, which have been lax and could be ripe for problems
- Delete warranty provisions for major weapon systems guarantees
- Repeal the Byrd Amendment (regarding lobbying disclosure)
- Implement a major overhaul of the laws pertaining to small business and small disadvantaged business
- Outline a new alternative approach for dealing with technical data [Ref. 52:p. 33]
- Reduce number of protest forums
- Disclose more information to unsuccessful bidders in debriefings
- Exempt contracts below \$100,000 from most socioeconomic requirements [Ref. 53:p. 66]

g) Defense Acquisition Workforce Improvement Act (DAWIA)

In response to recommendations by the Packard Commission, the House Committee on Armed Services conducted an in depth assessment of the acquisition work force. On 8 May 1990, the committee produced a 776-page document,

"The Quality and Professionalism of the Acquisition Workforce." It focused on four major questions:

1. Are the services appointing program managers, deputy program managers and contracting officers with the experience, education and training required by law and regulation, and are program managers being retained in their positions the mandatory four-years or completion of a major milestone?
2. Is there a career program structure to develop qualified and professional acquisition personnel--both military and civilian?
3. Is there an appropriate mix of military and civilian personnel within the workforce?
4. What impediments exist that must be overcome in order to develop a quality, professional, workforce? [Ref. 54:p. 2]

The committee's conclusions were grim. Only 11 percent of the 94 reviewed Program Manager turnovers complied with Public Law 98-525. The average tenure of a Program Manager was 24.6 months--not 48. No effective structure was in place to develop the acquisition workforce. Whereas approximately 98 percent of the military members of the workforce held college degrees or higher, less than half of their civilian counterparts held equivalent education. Acquisition experience was not structured. Civilians remained in positions for too long and were not exposed to the full spectrum required to assume positions of leadership. Military officers did not remain in a position long enough before being transferred to the next position. Breadth of experience was provided at the expense of depth of experience. Acquisition education at the Defense Systems Management College, Air Force Institute of technology and the Naval Postgraduate School was predominantly provided to military officers who would later manage programs, but not to their supporting staffs.

In November 1990, Congress passed the Defense Acquisition Workforce Improvement Act (DAWIA) to improve the effectiveness of the military and civilian acquisition workforce through formalized training and career development. The corresponding DoD order, DoD 5000.52, established:

- Education, training and experience standards for each acquisition position
- The Director of Acquisition Career Management (DACM) for each service and OSD
- An Acquisition Corps of (0-4) or GS/GM-13 and above

h) National Performance Review (NPR)

Created on March 3, 1993, the National Performance Review was tasked to make Government “work better and cost less.” Vice President Gore submitted the original report *From Red Tape To Results: Creating a Government that works Better and Costs Less* on 7 September, 1993. This original report made 384 recommendations, including acquisition reform and other measures, for anticipated savings of \$108 billion. [Ref. 48:p. 1]

3. From Defense Industrial Base to U.S. Industrial Base

The DoD responded to the NPR with impressive measures. It reduced its workforce by 12 percent, 110,000, by the end of 1995, with anticipated total personnel reductions of 23 percent, 210,000, by FY-1999. Additionally, DoD anticipates \$12.3 billion in savings from NPR related acquisition legislation, the 1994 Federal Acquisition

Streamlining Act and the 1996 Federal Acquisition Reform Act. These acts, covered in the next section, have successfully shifted procurement from the post cold war defense industrial base to the commercial U.S. industrial base. [Ref. 49]

a) The 1994 Federal Acquisition Streamlining Act (FASA)

The 1994 Federal Acquisition Streamlining Act (FASA) impacted all areas of the procurement process. The changes due to the FASA occurred in five general areas. Authorization was granted to conduct Pilot Programs. Commercial items and practices were emphasized. Simple Acquisition Threshold (SAT) and Simplified Acquisition Procedures (SAP) were established. A Federal Acquisition Computer Network (FACNET) was created. Last of all, requirements for Cost and Pricing Data were reduced. [Ref. 42]

Authorization to conduct pilot programs was granted in order to gain measurable insight into possible returns from acquisition reform efforts. Certain reporting waivers were granted and the programs were tied directly to the acquisition reform Benchmarking Group that are discussed in a later subchapter. [Ref. 42]

Commercial Items and Practices. As with Federal Acquisition Regulations (FAR) parts 10, 11 and 12, FASA emphasized the role of market research, created a preference for purchasing a commercial item, eliminated statutory restrictions on commercial item purchase and provided for use of commercial practices where commercial items were not purchased. [Ref. 42]

The Simplified Acquisition Threshold (SAT) and Simplified Acquisition Procedures (SAP) were created. The SAT was set at \$100,000. All procurements less than the threshold (99 percent of all DoD contracts) were relieved from numerous statutory requirements. Simplified procedures (SAP) were set up to accommodate the inclusion of FACNET and electronic commerce/ electronic data interchange (EC/EDI). FAR part 13 was altered accordingly. [Ref. 42]

The Federal Acquisition Computer Network (FACNET) was created. This provided the opportunity to “push” Requests For Proposals (RFPs) to the vendor instead of making the vendor “pull” them from sources similar to the *Commerce Business Daily* (CBD). It also provided for reduction in administrative costs and delays associated with excess paperwork. FAR parts 4 and 13 were also altered accordingly. [Ref. 42]

The last general area of improvement under FASA was in reducing requirements for Cost or Pricing data. This piggy-backed off of the effort to use commercial practices. FASA set a lower threshold of \$500,000 for this requirement and also provided for waivers and exceptions above this threshold. FAR subpart 15.8 was altered to accommodate this change to cost and pricing data. [Ref. 42]

b) The 1996 Federal Acquisition Reform Act (FARA)

The 1996 Federal Acquisition Reform Act (FARA) continued the streamlining efforts in legislative areas. FARA streamlined competition requirements. It reformed Information Technology (IT) acquisition by repealing former legislation (1965 Brooks Act) that had differentiated and prolonged IT procurement. In following, it

delegated IT management to a Chief Information Officer (CIO) in each of the Federal agencies and required the Office of Management and Budget to provide capital investment guidance. Additionally, FARA allowed contracting officers to limit the number of bidders considered in the competitive range and increased the “other than full and open competition” threshold from \$10 million to \$50 million. It also simplified and clarified confusing procurement integrity laws and further broadened FASA simplified acquisition thresholds to include all commercial items up to \$5 million. FARA was the second of a “one-two punch” that showed that congress was “on board” with acquisition reform. [Ref. 43]

c) Single Process Initiative

On 8 December 1995, Secretary Of Defense Perry announced a “Single Process Initiative.” Multiple procedures were being used to produce like items for different customers within DoD. With each additional production process, specification, or standard, the cost of production increased. DoD would pursue a sweeping change to all current and future defense contracts to consolidate or eliminate multiple processes, specifications and standards in contractor facilities. This change would occur on a facility-wide basis. [Ref. 56]

d) DoD 5000 Series Update

Secretary of Defense Perry cemented the new wave of acquisition reform efforts by revamping the department’s regulations on acquisitions--the DoD 5000 series. Published in March of 1996, the new update included six new themes that are now

considered the six themes of acquisition reform. The first theme of *teamwork* optimizes overall performance. This is done by creating cross-functional integrated product teams (IPT) that surface problems “up-front and early” in the development process. The second theme of *tailoring* enables the Milestone Decision Authority to apply common sense and sound business practices in accomplishing tasks in an expedient and effective manner. No two programs are identical, and tailoring allows for the flexibility required. The third theme of *empowerment* balances responsibility with authority. The rescintion of volumes of guidance, documentation and regulation effectively shifts the focus back on the user representative, the Program Manager, who is empowered to take actions in an upfront and expeditious fashion. The ability to affect the life cycle cost of a program is exponentially related to the timelines of decisions. This relationship is illustrated in Figure 3.3.

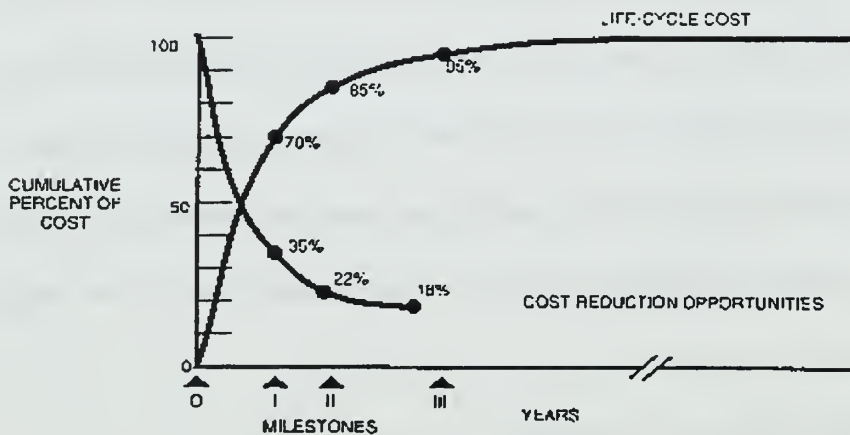


Figure 3.3, Life Cycle Cost Impact vs. Time [Ref. 45:p. 351]

The fourth theme of *cost as an independent variable* (CAIV) forces tough trade-offs between cost, schedule and performance in an effort to achieve the best value. Greater

use of *commercial products*, the fifth theme, recognizes the parity and often superiority of commercial items when compared to Government developed alternatives. The eighteen-month life-span for many technologies force “open system” commercial item procurement in order to keep a system from being obsolete the day it is fielded. The sixth theme of *best practices* encourages the use of the most effective tools to get the job done. [Ref. 47:p. 2]

The update to the DoD Directives 5000 series accomplished four important objectives. It incorporated FASA provisions and integration of IPTs. Secondly, it differentiated between mandatory and discretionary procedures. This increased flexibility and provided incentive to initiate new and creative procurement methods. The third accomplishment was that the update became more “user friendly.” The guidance was shortened and made available “on-line.” The fourth accomplishment was that it integrated procurement policies for weapon systems and automated information systems. The four objectives were accomplished using a relationship of the six themes of acquisition reform and enabling reform initiatives as illustrated in Figure 3.4. [Ref. 47:p. 2]

<i>Themes versus Enablers Matrix</i>						
Themes	Teamwork	Tailoring	Empowerment	CAIV	Commercial Products	Best Practices
Enablers (Acquisition Reform Initiatives)	IPPD/IPT	Open System Approach Statement of Objectives	IPPD/IPT	IPPD/IPT Minimize Support Costs	Open System Approach Technology Insertion	Open System Approach Statement of Objectives
		Perf-based Specs Single Process		Affordability Modeling & Simulation Reduce Cycle Times	ATDs / ACTDs Single Process	Perf-based Specs Single Process
		Non-Govt Specs / Stds Preference Best Value Contracting			Non-Govt Specs / Stds Preference Perf. Market Survey Use NDI	Non-Govt Specs / Stds Preference Best Value Contracting Use NDI
					Use COTS	Use COTS
					Performance-Based Specs	Modeling & Simulation
						Contractor Past Perf.

Figure 3.4, Reform Themes and Enabling Initiatives [Ref. 58]

4. History Summary

In this subchapter, the researcher has described the progression of the American weapons procurement process from one that converted “plowshares into swords” in time of need, to one that has spawned a sizable defense industrial base. Impressive weapons system performance resulted but, so too, did program cost, inefficiency and concern over national defense business ethics. This brought with it increased oversight and regulation which, in turn, resulted in greater and greater overhead costs. Overzealous focus on this oversight neglected the quintessential task of effective program management.

"Government saved pennies while billions quietly marched out the door," according to Dr. Jacques Gansler. Recent acquisition reform efforts seek to reduce the debilitating amount of regulation and return to "free market" commercial practices. This shift will

create what Mr. Norman R. Augustine, of Lockheed Martin, has termed a vibrant “industrial base for defense” from what used to be a “defense industrial base.” The next subchapter looks more in detail at acquisition reform catalysts. [Ref. 55:p. 46]

C. ACQUISITION REFORM GUIDING PRINCIPLES

“Everyone complains about the weather but nobody does anything about it.”

Mark Twain

The previously discussed history of acquisition reform is replete with studies and legislation aimed at optimizing cost, schedule and performance. Will the current efforts take root in a culture that has resisted so many previous attempts? Mr. Norm Augustine, citing budget pressures, the technology revolution, numerous world commitments and a reform focused Secretary of Defense, stated that the opportunity to reform the acquisition system has never been better. In an effort to infuse the recent legislation into the culture, Ms. Colleen Preston, Deputy Under Secretary of Defense (Acquisition Reform), has consolidated recent initiatives into her “Ten Guiding Principles of Acquisition Reform.” These ten principles summarize what exactly acquisition reform is and what it attempts to accomplish:

1. Empower People to Manage--Not Avoid Risk

- Delegate authority and results
- Encourage innovation by issuing guidance not rules
- Train in a multifunctional environment
- Commit to quality through customer focus and continuous improvement

2. Operate in Integrated Product Teams

- Replace functional stove pipes with integrated program teams
 - Manage with early insight on program issues, rather than after-the-fact oversight
 - Resolve issues at the lowest possible management level
 - Use concurrent engineering to integrate process and product development
 - Partner & team with industry
- 3. Reduce Cycle Time by 50%**
- Zero-base functional requirements
 - Tailor the process to the specific acquisition
 - Waive or seek relief from low value added directives
 - Structure so that fewer people are involved and the need for coordination is reduced
- 4. Reduce Cost of Ownership**
- Manage overall life cycle cost not just initial acquisition cost
 - Treat total cost as an independent variable relative to user requirements
 - Make cost performance trade-offs early in the acquisition process
 - Put high priority on logistics and support cost visibility
- 5. Expand use of Commercial Products and Processes**
- Research the global commercial market before establishing new development efforts
 - Begin dialogue with industry early in requirements development process
 - State requirements in terms of essential performance SPECS
 - Give priority to customary commercial practices
- 6. Use Performance SPECS and NON-Government Standards**
- Minimize Government unique terms and conditions
 - Use performance SPECS as the preferred choice for all programs
 - Use non-Government standards when performance SPECSs are not practicable
 - Use MIL SPECS/STDs only as a last resort with an appropriate waiver
- 7. Issue Solicitations that Reflect the Quality of a World Class Buyer**
- Write cohesive statements of work that specify "what" not "how"
 - Minimize data requirements to emphasize electronic commerce and product over paper

- Integrate oversight requirements with contractor program management scheme
- Coordinate in advance to gain mutual understanding of requirements and capabilities
- Maximize use of FACNET and simplified acquisition procedures

8. Procure Goods & Services with "Best Value" Techniques

- Evaluate bids & proposals on a total cost of ownership basis to seek out qualities other than lowest price
- Use contractor past performance as a key factor in source selection
- Reduce the time and cost of making the award
- Debrief offerors promptly and openly to avoid misunderstanding and protest

9. Test & Inspect in the Least Obtrusive Manner to Add Value to the Process or Product

- Make testers/evaluators value-added team participants from the start, not inspectors after-the-fact
- Take advantage of contractor testing
- Use modeling and advanced simulation to save time and reduce cost
- Achieve quality with statistical process control rather than with end item inspection

10. Manage Contracts for End Results

- Focus on the customer and the product or service required
- Control only the performance SPEC giving contractors freedom for design innovation
- Acquire technical data rights only to extent necessary for breakout and spares procurement
- Aggregate contracts and acquisition phases to benefit from stable contractor operations
- Operate on the basis of trust and tailor oversight to estimated performance risk [Ref. 50]

The degree to which these recent reform's "guiding principles" have been "value added" will determine if, indeed, this is true reform or just another cycle of popular "buzzwords." The next subchapter discusses recent attempts to measure the outcome of

efforts thus far and results from pilot programs authorized in FASA. Feedback as to acquisition reform's impact on the V-22 program is analyzed in Chapter IV.

D. ACQUISITION REFORM BENCHMARKING GROUP (ARBG)

Chartered in September 1995, the ARBG was tasked with determining the results of current acquisition reform efforts. Metrics baselines were developed using the best commercial industry and DoD had to offer. General data from DoD and specific data from five pilot programs were collected and analyzed over a year and a half. The results of the ARBG efforts were published in June of 1997.

According to the ARBG, some dramatic improvements have occurred as a result of the most recent acquisition reform efforts. The seven top gains in efficiency, listed in the Executive Summary of the Final Report, included:

- New Start program development cycles of 88 months versus an historic average of 115 months. Post-1992 major acquisition programs show a 25 percent reduction in planned cycle time.
- Reported average cost growth of zero (0) for all Major Defense Acquisition Programs (MDAPs) in 1996.
- Logistics Response Time (LRT) for both consumable and troop support items (clothing, medical and subsistence items) continues to improve as a result of reengineering business practices under Shift to Commercial Practices (SCP) initiatives, such as prime vendor (PV) and virtual prime vendor arrangements.
- In a USDA(A&T) survey of MDAP Program managers, \$42 billion in estimated cost reductions. Reduction resulting from regulatory oversight in the average cost premium of 50 percent.
- "Reinvention Laboratory on Oversight" identified and tested process improvements and targeted \$145 million of annual cost savings and avoidances.
- A 50 percent reduction in Class I Engineering Change Proposals (ECPs) [Ref. 46:p. 1-1]

The group also concluded that there were still areas that needed more effort.

These areas included:

- Despite significant emphasis on cost as independent variable (CAIV) and an average cost growth of zero in 1996, some MDAPs continued to incur cost growth primarily due to funding instability. Unfunded contingency operations and underfunded readiness requirements are leading to a shift of available resources from investment accounts to O&M accounts. Much of this cost increase was attributed to inadequate methods for managing technical/financial risk.
- The cost of DoD's purchasing continues to be twice as high as comparable high technology commercial segments.
- Although product/process conformance has increased, development programs have not matured sufficiently to assess the effect of acquisition reform on weapon system performance. [Ref. 46:pp. 1-1,1-2]

The ARBG reported on many acquisition improvements, across the board, and what MDAP acquisition can look like for new start programs--given certain waivers. Initial reports are in and they are positive. What it did not report was actual "feedback from the field" for the majority of the programs that were not "pilot programs." The next chapter provides feedback on acquisition reform initiatives in one such program, the V-22 Osprey program.

IV. ACQUISITION REFORM AND THE V-22

"A person who has a cat by the tail knows a whole lot more about cats than someone who has just read about them."

Mark Twain

A. INTRODUCTION

Since given "history's greatest mulligan" back in 1992, the V-22 program team has capitalized on the opportunity. Seldom is a program given such a second chance, and the V-22 team has been more than ready to adapt to the initiatives of acquisition reform. It has come a long way. In 1996, this once-cancelled program was nominated by the Naval Air Systems Command for the "David Packard" Excellence in Acquisition Award and, just recently, received the Department of the Navy's Certificate of Excellence for Acquisition Reform. The V-22 program has the new acquisition reform "cat by the tail," and a great deal can be learned from its experience. This chapter outlines what acquisition reform measures are in place in the program and the effect they have had. It then briefly examines the "jointness" of the program. Finally, it discusses recommendations that the prime contractors suggest may provide continued reform.

B. V-22 ACQUISITION REFORM TOOLBOX

The V-22 program office (PMA-275), as with every program, seeks to be "the smartest, most responsive buyer of the best goods and services, that meet the warfighter's needs, at the best value over the life of the product." [Ref. 69] Conforming the V-22 program's mission to DoD mandated acquisition reform has resulted in some initiatives playing a starting role while others have been sidelined. Accordingly, the use of reform

initiatives to accomplish “value added” results is paramount--not the use of reform initiatives, in and of themselves, just to comply with a new DoD project. After a brief look at an observed shift in the program’s business process, this subchapter examines the addition of acquisition reform’s guiding principles, as outlined in Chapter III, to the V-22 program’s toolbox and the impact they have had.

With the cyber-paced business world of today, an essential element of successful management is the ability of the business to learn and adapt to unforeseeable future forces. A learning company’s bottom line is continuous process improvement. Integrated Definition (IDEF), the recognized process outline for examining Business Process Reengineering (BPR), recognizes that process throughput is increased as controlling oversight shifts to enabling insight.

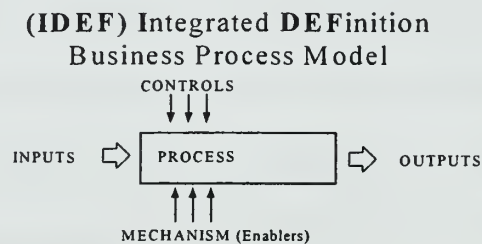


Figure 4.1, IDEF Process Model [Ref. 61]

This shift has happened with acquisition reform and the V-22. The overwhelming response from those in the V-22 program to acquisition reform is that it has enabled the program office to enlist the support of its chain of command instead of avoiding its scrutiny. This shift has freed the PM and his support team to initiate imaginative

solutions or save the effort required hiding such work. In an IDEF outline of the acquisition process, this observed change shifts the chain of command from the status as a “controller” to one of an “enabler.” The chain of command now supports the program office instead of “watching over it.” This freeing up of the V-22 program office to accomplish its mission is the catalyst for the rest of the efforts listed in this subchapter.

1. Empower People To Manage—Not Avoid Risk

The first principle of acquisition reform, according to the Deputy Under Secretary of Defense (Acquisition Reform) Colleen Preston, is to “empower people to manage—not avoid risk.” Risk management is an important recurring theme in reform. The eleventh of Deputy Secretary of Defense Carlucci’s thirty-two initiatives back in 1981 called for increased visibility of technical risk in programs. [Ref. 56] Basic courses in program management taught at the Naval Postgraduate School (NPS) and throughout the Defense Acquisition University list effective formal risk management as the quintessential element of any successful program. V-22 Deputy Program Manager, Barbara Smith, agrees whole-heartedly and feels that effective risk management is the key to the new Osprey’s success. The program’s combination of Earned Value Management (EVM) and an in-house process, coordinated through both the contractor and the Government, is recognized by many as the best risk program at NAVAIR.

The EVM system in place with the V-22 program demonstrates to the Government that Bell Boeing effectively uses cost and schedule management control systems and permits the Government to track program risk status. The December 1996

shift from CSCSC to EVM put greater Government trust in Bell Boeing and reduced the time and effort expended by the Government in undue oversight. Since the 1994 shift of Integrated Baseline Review (IBR) responsibility to the program office from the comptroller, the program has actively used CSCSC, and now EVM, data to manage the program and its risks. [Ref. 62]

The tracking of the Integrated Test Team (ITT) progress is a good example of the use of EVM. Bell Boeing tracks not only flight hours, but also the value achieved in the flight hours by “event” accomplishment. Figure 4.2 illustrates the tracking of ITT progress. Planned, earned, actual and scheduled flight time and events are tracked and variance is calculated. With this information, the ITT, JPO and PMA-275 can identify possible risks and enter them into the in-house risk management process for action.

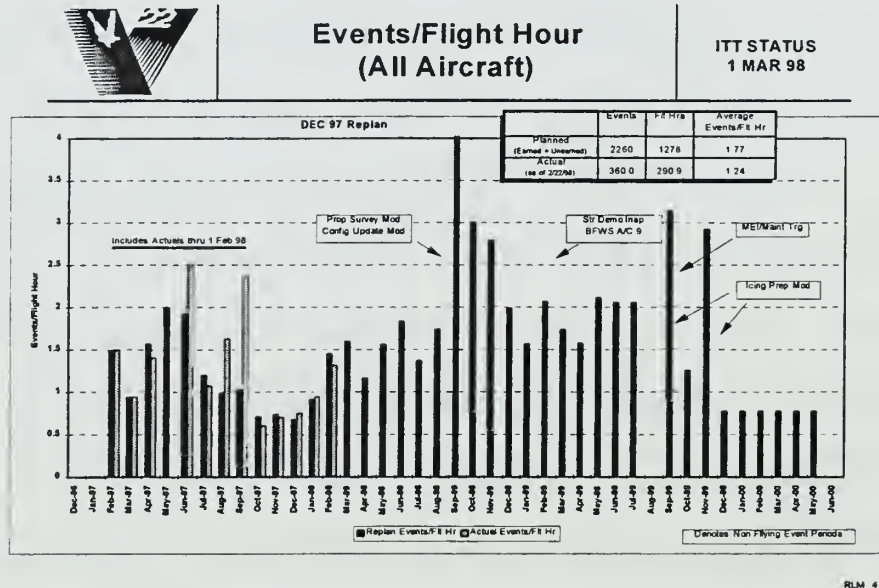


Figure 4.2, ITT Earned Value Management / Risk Management [Ref. 63]

The V-22 risk management process encourages an open, risk-aware culture in which risk management is considered everyone's job. Identifying possible risks is encouraged. This minimizes the unknown risks and makes program planning more effective. A formal systematic process exists, enabling those in the program to identify, categorize, assess, analyze, mitigate, monitor and dispose of risks as follows: [Ref. 57:p. 46]

- Risk Identification. Risk is identified through many various means: IPTs, schedule network analysis, test results, meetings and discussions, technical performance measurements, cost, schedule and control system and any other means.
- Risk Characterization. Once identified, a risk is submitted on a risk identification form. This form is submitted to the Bell Boeing program office who, in turn, forwards the risk form to PMA-275 and the members of a Risk Management Control Board (RCB). The RCB rates the risk as high, moderate, or low and decides whether or not to track the risk. If so, it enters it into a data base.
- Impact Assessment. "What if?" questions are asked. Impact if no action is taken, impact if the most likely action is taken and impact of the action itself are analyzed by the RCB. The worst of the three is entered into the data base.
- Analysis of Plan. After being entered into the database, the risk is analyzed by the appropriate IPT and a plan for mitigation is developed. This plan is presented to the RCB for approval on a standard "potential risk item" plan sheet. Any plans disapproved are revisited later or closed out.
- Mitigation/Implementation of Plan. If required, concurrence from PMA-275 PM, contractor PM, or PCO is obtained, the risk is assigned a permanent identification number, a planned update is set, and resources and funding issues are resolved. The planned update is dependent on the requirements of the mitigation plan. At a minimum, moderate and high risk plans will be updated on a monthly basis.
- Monitoring Progress. IPTs monitor risks and the RCB reviews them. Risk status is covered in design reviews and program management reviews.

- Disposition. All risks are assessed for weekly review by the risk management team. Upgrade, downgrade, open, close and monitor decisions are made to the risk status. [Ref. 57:p. 46]

2. Operate In Integrated Product Teams

The operation of integrated product teams (IPTs) and analysis and integration teams (A&Is) in the program is identified by both the contractors and Government as a vital catalyst to the V-22 program's jump-start in early EMD and to its continued success today. The use of IPTs in the V-22 program were in full operation before Secretary of Defense Perry ushered in the concept May 10, 1995. Boeing had used "multi-discipline teams" in the successful development of the commercial B-777, F-22 and Hard Mobile Launcher (HML) and included them in the 1992 V-22 EMD proposal. As Boeing B-777 engineers were assigned to the new Osprey, they brought with them IPT know-how and expertise. By the summer of 1993, PMA-275 had developed the present IPT concept of operations, charters for each of the 72 IPTs (currently 74), and a matrix plan to staff all of them. [Ref. 70]

The IPT Concept of Operations used in the V-22 is a method to optimize concurrent engineering. Concurrent engineering is "the consideration of all design aspects at one time in the early stages of the design process" and requires customer input [Ref. 58:p. 1]. IPT operations are organized into four tiers and a management board:

- Tier IV. Key V-22 Government personnel assigned as Primary IPT coordinators (PIC). PIC interface directly with bell Boeing counterparts. Some PICs may be full time IPT members. DCMC personnel are integrated to provide matrix support but are not tasked to supply procuring agency roles or responsibilities. The PIC receives assistance from the Design Engineering

Team (DET), Maintenance Engineering Team (MET), Systems Engineering Team (SET), Integrated Logistics Support Management Team (ILSMT) and members of the Assistant Program Manager for Logistics (APML) staff.

- Tier III. Key senior Government personnel will be assigned to this first level analysis and integration group (A&I). These personnel include SET, Class Desk (Assistant Program Manager (Science & Technology)) and APML representatives. These personnel are to coordinate all IPTs in their cognizance.
- Tier II. The Class desk and APML provide Government interface for the company level A&I. Preliminary Design Review (PDR) and Critical Design Reviews are examples of when Tier II interface is required.
- Tier I. The Program Management personnel (PMA) and NAVAIR SET provide this input. They are assigned to the Air Vehicle A&I. Decisions can not exceed the terms of the contract as the PCO is the only Government representative with formal authority to change the terms of the contract.
- V-22 Program Management Board. The PMA-275 Program Manager, PCO, and Bell Boeing Program Director provide guidance and direction when not resolvable at the Air Vehicle A&I. Any issues requiring change in terms, conditions, or price of the contract, are forwarded to this board.

The charters for each of the 74 IPTs include up to six sections. The *purpose* section provides the mission statement for the team. The *products* section lists the end item deliverables required of the team. The *intermediate products* section lists the en-route deliverables needed to get to the end items. The *boundaries* section lists those items that limit the scope of the team's efforts. Quality, cost, schedule, technical and weight are examples of this. The *tasks* section of the charter includes those actions required to produce the intermediate and final products. An optional sixth section is the *membership* section. It outlines who leads the IPT and who can provide input.

The IPT organization and matrix support includes vital contact data. In the 1996 report on IPTs by the Center for Naval Analysis (CNA), communication was linked to

successful IPTs in the same manner that location is related to real estate. Communication lines in V-22 IPTs are clear and unencumbered. [Ref. 59]

Co-location and technology were also noted by CNA for optimizing IPT performance. PMA-275's recent move to Patuxent River Naval Air Station's IPT building has further enabled it to co-locate a number of its logistic, engineering, financial and program management personnel. Other matrix staff are either an office away in the same building or a few blocks away. Where IPT members are separated physically, the program makes extensive use of their e-mail and video teleconference provided by Bell Boeing's joint program office--also located at Patuxent River.

3. Reduce Cycle Time by 50 Percent

The cycle time for this program has not been reduced appreciably even though numerous time saving measures have been incorporated. After analyzing risks involved, concurrent EMD and LRIP cycles were run to reduce program cycle time. Additionally, the program attained a waiver from mandatory Government specifications and standards for the 1996 Bell Boeing LRIP contract. With over 14 years and \$5 billion invested in the program, forcing Bell Boeing to develop new commercial specifications and standards would have been counter-productive. Bell Boeing was not prepared for the switch at the time, but has since submitted "single process initiative" (SPI) requests that, likewise, may reduce cycle time. These SPIs are discussed in greater detail in section five of this subchapter. One additional time cutting measure of note is the tailoring of Boeing's "drawing-to-tooling" process. This ten-level process inherited from the B-777

engineers was pared down to a three-step process. Even with these time saving measures and the new start back in 1992, the program is not scheduled to reach MV-22 IOC until 2001. [Ref. 62]

The intent of measuring cycle time is to determine how long it takes for a system to get in a warfighters' hands. One area, at times, overlooked is the fielding time—how long it will take to field a system to full operating capability (FOC) once it has reached IOC. From the warfighters' perspective, a long drawn out fielding time can counter any benefits gained from a reduced cycle time.

A big return in this area of fielding time has been made by the V-22. Recent efforts by the contractors and the program office to increase the production rate has shaved off eight years of the life of the buy and the warfighter will have full capability sooner. . . and at less cost. The next section discusses this reduction in cost of ownership.

4. Reduce Cost of Ownership

Reduction of the cost of ownership is the fourth guiding principle of acquisition reform. To accomplish this, the V-22 program manages the overall life cycle cost and front-end costs, treats cost as an independent variable (CAIV), fights for stability and is preparing its first multiyear budget proposal.

The 1994 Defense Acquisition Board (DAB) Acquisition Decision Memorandum (ADM) limited annual V-22 outlays to \$1 billion. This, in effect, exchanged the most efficient cost of ownership for near-term fiscal savings. On 1 October 1996, Bell Boeing

executives met with Under Secretary of Defense Kaminski to address this issue and made three recommendations:

- Increase first three MV-22 lots to: 5/FY97-12/FY98-24/FY99 and 36/FY00
- Establish joint commercial practices/contractor logistics support team.
- Prepare multi-year procurement proposal [Ref. 60]

Since then, the results of the QDR endorsed the need for an increased procurement rate, but not at the originally recommended level. The program has been able to increase its procurement to 5 for FY-1997, 7 for FY-1998 and FY-1999 and sustain procurement from FY-2004 on at 30. This would have driven total costs down, but a reduction in total production quantity from 523 to 458 countered these efforts. The flyaway price per aircraft remains approximately \$32 million—23 percent lower than the FSD cost of \$41.8 million. [Ref. 66]

The program has put a high priority on reducing logistics and support costs. Contractor Logistic Support (CLS) recently has been approved for the V-22's largest commercial item, the AE-1107C engine. CLS is still being considered for the Bell Boeing airframe itself. The recent contract with Allison Engine Company, the prime contractor supplying the engines as Government furnished equipment (GFE), is a textbook example of how a program can use acquisition reform to reduce the life cycle cost of the program.

In response to a "what, not how" RFP, Allison presented two offers: a nine inch thick standard response, and one quarter inch thick acquisition reform response. Allison

recommended a standard three-tier maintenance option and an Operational to Depot (O to D) concept similar to the way they support major airlines. This Power By The Hour® support system resembles a reliability improvement warranty with a commercial depot. After thorough analysis, the PMA-275 logistics personnel discovered, with a few key improvements, that the O to D program could, in fact, save approximately 30 percent in support costs from the proposed alternative three tier maintenance system used throughout the services today. Up front acquisition costs would increase from \$1.8 million to \$2.1 million per engine, but this would be more than compensated for by total coast of ownership savings from the Power By The Hour® O to D support program.

Power By The Hour®, a concept borrowed from Allison's parent company Rolls Royce, is a bit of a misnomer. "Power by the equivalent specification mission hour" (ESMH) is more in line with what this program entails. ESMH is the result of converting various life damage factors to a mission hour equivalent. Normal operation of an engine includes a certain degree of wear to selected dynamic and hot section components over the life of the engine. Stress rupture/hot corrosion (SR/HC) and 21 low cycle fatigue (LCF) factors determine this wear. As an engine is operated, these factors are accumulated. The harder an engine is worked during a mission, the more stress factors are accumulated. Military Engine Performance Specification 937 describes five missions that the V-22's engine will endure:

- Vertical Assault
- Search and Rescue

- Special Operations
- Post Maintenance Check Flights/Test Flights
- Cargo Flights [Ref. 64]

The program office estimated how much of each flight regime was anticipated by the engines and weighted the missions accordingly. With this mix, an expected 10,000 ESMH life of the contract was factored per engine to get the useful life of the engine. The resultant expected life at \$200 per ESMH is the cost of the program support.

The risk in this process is in the determination of mission load. The engine LCF and SR/HC accumulate a lot more quickly in a MILPRF 937 test mission than in a SOF mission. The former includes great engine and dynamic component fluctuation and the latter does not. However, repeated rugged training for a SOF mission that only entails a brief period of high engine workload may produce similar engine wear. The degree that the engines parallel the predicted workload will determine, ultimately, how successful this contract is for the Government and Allison as well. [Ref. 64]

Sun Tzu said, "Opportunities multiply as they are seized." Acquisition reform provides many opportunities for those imaginative and courageous enough to seize them. Allison, it appears, has done just this. Whether or not Bell and Boeing try to enter into the CLS arena is yet to be determined. Both Government and Boeing representatives inferred that Boeing is actively seeking to provide CLS for the airframe. However, some believe that with its high degree of current business, Bell has not felt the "pinch" financially enough to seek out new methods for retaining future Government business. Power By The Hour® is a means for Allison to guarantee business until 2045, the

expected end of V-22 service life. Of course, Allison must deliver a good product, but the vehicle exists for Allison to survive possible continued future budget cuts in defense. CLS could provide the same stability for both Bell and Boeing.

Throughout the life of the V-22 acquisition process, CAIV has been applied to ensure program affordability. CAIV is a twofold process. Initially, it is a planning activity to establish and adjust program cost objectives (procurement cost and operations and support costs) through cost-performance trade-offs. Thereafter, CAIV is an execution tool used to stay within the cost objectives set in planning. In this aspect of the CAIV process, the cost objective is translated into a specific design using design to cost (DTC) and cost of ownership techniques. Inherent in both is the requirement to establish and track cost metrics.

Both aspects of CAIV are present in the V-22 program's CAIV Program Implementation Plan. Up-front analysis and affordability trade studies are used along with best value analysis to determine the biggest "bang for the buck." After cost objectives are set, the funding profile baseline subtotals for RDT&E, PROC, MILCON and O&S are used as benchmarks for the later execution portion of the CAIV plan. The execution portion of the V-22 CAIV Program Implementation Plan includes both current and future cost reduction initiatives.

The V-22 CAIV program includes four current cost reduction initiatives:

- Setting realistic and aggressive cost objectives
- Managing risk to achieve cost, schedule and performance objectives

- Devising appropriate metrics for tracking progress in setting and achieving cost objectives
- Motivating and incentivizing Government and industry managers to achieve program objectives

The V-22 CAIV program includes five future reduction initiatives:

- Integrated Logistics Support
- 2001 upgrade
- Multi-year production
- O&S cost drivers
- V-22 process improvement program (Value Engineering)

Returns from the V-22 CAIV program have resulted from both the current and future initiative areas. One notable example of current initiatives was the cutting of FSD flyaway cost by 20 percent. The EMD fly-away cost target of \$33.4 million was actually reduced even further to \$32 million, as stated earlier. A notable future initiative example is the embedding of various radio assemblies into the ARC-210 radio. This initiative is saving \$120,000 per aircraft and \$54,960,000 across the program. Additional savings in future initiatives could be realized by CLS, but as this is a current contract issue, O&S figures are not releasable.

CAIV progress is tracked with metrics. This is done on a macro and micro level. In 1996, the Cost Analysis Improvement Group (CAIG) set the baseline for the program's CAIV program in four budget areas: research, development, test and evaluation

(RDT&E), procurement (PROC), military construction (MILCON) and operations and support (O&S). Cost comparison is conducted every six months to track the plan's progress. One example of the many metrics on the micro level is the systems engineering metric of cost. After initial targets were set for flyaway cost and O&S cost, these targets were passed down to the IPTs for action. The design to cost (DTC) member of each IPT then presented the challenge before team members who collectively established metrics and met each challenge. One IPT devised a way to reduce 36 parts into one single casting, reducing machine time by 70 percent and recurring costs by more than 50 percent. [Ref. 71]

Effective cost management of the V-22 program includes fighting program funding instability. This instability for DoD and the V-22 program has been heightened by recent contingency operations. Contingencies, invariably require more funding than initially anticipated. Figure 4.3, at the top of the next page, illustrates this funding variance. The services offset this operational variance with acquisition funding. Each service chooses the manner in which to transfer these funds, but nonetheless, an average of \$2 billion in investment funding (PROC and RDT&E) migrates each year to operations and support (O&S) for contingencies.

The Operational Contingencies Problem

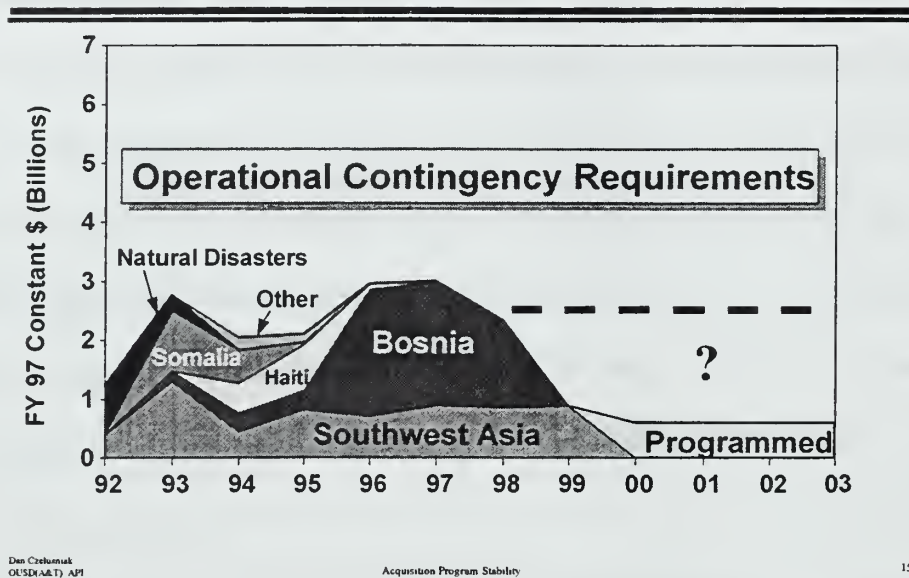


Figure 4.3, DoD Operational Contingencies Funding [Ref. 61]

One method the Navy uses to pay for its share of these contingencies is to transfer a percent of each acquisition program's funding over to O&S. This post appropriation "taxation" of the program's funding can be likened to a renegade teenager's sporadic use of a parent's credit card. Financial planning is never solid due to the ever-present possibility that funding, thought to be secure, can be pulled at any moment. Figure 4.4 illustrates the amount of "taxation" the V-22 program has suffered in the past years. This "taxation" is singled out by the V-22 PM, COL Nolan Schmidt, as the number one issue that must still be addressed by future acquisition reform efforts. A \$3 billion bill before Congress to fund the contingencies in Bosnia and Iraq, external to the defense budget, is an interesting recent development and could reduce the instability on major defense acquisition programs (MDAPs) like the V-22. [Ref. 65]

TAXES (\$ MILLION)			
\$M	<u>FY 96</u>	<u>FY 97</u>	<u>FY 98</u>
R&D	44.3	39.5	37.1
APN	1.5	20.9	21.4
		*54.1	
TOTAL	45.8	114.5	58.5
* WORKING CAPITOL FUNDS			

Figure 4.4, Taxation of V-22 Funding [Ref. 62]

One final area of effort by the V-22 program to lower life cycle costs is in the use of multi-year contracting. This had been recommended as far back as the Packard Commission report, but the recent emphasis by acquisition reform has made this a reality. The V-22 program is currently putting together its first multi-year proposal. The returns from a multi-year contract should be a three to four percent savings. [Ref. 66]

5. Expand Use of Commercial Products and Processes

The fifth guiding principle is the expanded use of commercial products and practices. This section outlines related program efforts and results. First, a list of initial EMD phase commercial products and processes is outlined. This is followed by a look at a cutting edge electronic technical manual program. An examination of the single process initiative's impact on the program wraps up the section.

a) Commercial Products and Processes

The list below from the Navy's acquisition reform "Navy Success Stories" homepage sums up an impressive array of commercial products and processes used in the V-22 program since its transition from full scale development (FSD) to engineering manufacturing and development (EMD) in 1992 [Ref. 68:p. 2]:

- **Concurrent Product Definition** - Integrated product teams simultaneously commence all product life-cycle activities from concept definition through final disposal. Subsequent manufacturing and engineering activities are conducted in parallel.
- **Digital Design Applications** - Computer Aided 3-Dimensional Interactive Application(TM) (CATIA) is a commercially available product which provides a single-source, sole authority, digital database for engineering, manufacturing and test. It allows 100% digital product definition (a paperless design); real-time, remote design participation by subcontractors; eliminates mockups, master models and gauges; and supports digital tool applications in the manufacturing process. A Boeing adaptation to CATIA called "Fly-Through" permits designers and manufacturers to digitally pre-assemble the aircraft, thus visualizing design definitions and allowing the resolution of problems prior to assembly. The use of a single database by all manufacturers results in accurate production at hundreds of locations worldwide. These digital design applications have assisted in reducing the aircraft part count by 36%; reducing fastener count by 34%; reducing error change and rework drawings by 85%; and reducing composite material scrap by 74%.
- **Fiber Placement** - An automated method of laying graphite material on a compound curvature, this process harnesses CATIA to a large, numerically controlled composite tool, resulting in the fabrication of large components that are stronger, lighter and cheaper than comparable hand laid ones. The process has resulted in a 66% savings in man-hours and an assembly cost reduction of over 90%. Additionally, the process is repeatable and easy to modify.
- **Advanced Technology Assembly** - A process that reduces the number of assembly jigs, tooling locators and the time to set them up, resulting

in tighter tolerances, more accurate location of parts, reduced man-hours and the virtual elimination of shims in the assembly process.

- Integrated Wiring System - Replacing the "spider web" wiring in most aircraft, these woven ribbon cables separated by shield foil to prevent cross-talk and electromagnetic interference, provide significant cost, weight and space savings. Fabrication is simple and repeatable.
- Weight Reduction Program - As the aircraft transitioned to production, an aggressive weight reduction program was initiated which re-evaluated the entire structure of the FSD airframe. Trade studies examined current and new designs for affordability, functionality and ease of manufacture. An expanded use of "Design-to-Cost" metrics was developed to serve as an engineering tool for assessing the new designs. The resulting EMD design, executed with high speed milling and fiber placement processes, has eliminated over 1800 pounds from the FSD design. [Ref. 68:p. 2]

b) Interactive Electronic Technical Manual (IETM)

Additionally, the program is working on a level four interactive electronic technical manual (IETM). An IETM provides proficiency level appropriate direction for aircraft maintenance personnel. A ruggedized portable IETM is hooked up to the aircraft and the aircraft provides data as to what components require maintenance. The IETM then provides guidance on how best to accomplish it. As technology improves, the program has incorporated a pre-planned-product improvement (P3I) to upgrade the system to a fully interactive level five IETM.

c) Single Process Initiative

The single process initiative (SPI), as outlined in the last chapter, provides a method to implement acquisition reform's goals into ongoing contracts. By eliminating

redundant "no value added" processes, it is intended to reduce contractor operating cost and produce cost, schedule and performance benefits for the Government. This initiative is crucial to acquisition reform's implementation for ongoing programs like the V-22.

The single process initiative has been embraced by the contractors, who have submitted no less than 45 SPI recommendations for V-22 production facilities. Bell Helicopter Textron has submitted 13, Allison Engine Company 11 and Boeing Vertol 21. Not all SPIs submitted are approved, however. The 120 day approval process, illustrated in Figure 4.5, separates the wheat from the chaff. Of those initiatives submitted roughly one third have been refused. Illustrated in Figure 4.5 is Boeing's process for the V-22. Bell and Allison SPI processes are similar.

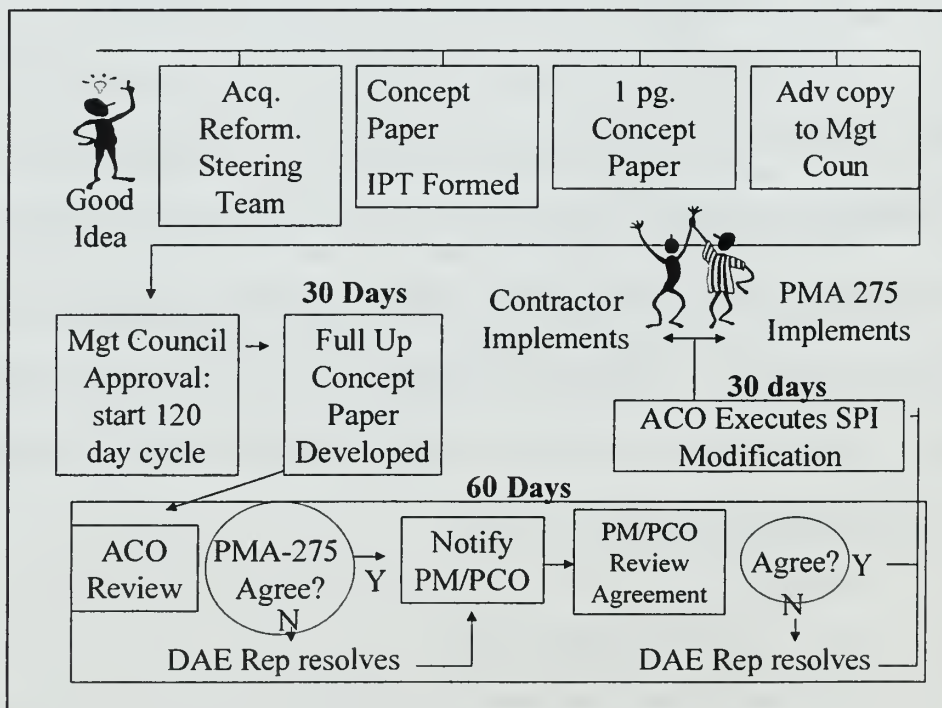


Figure 4.5, V-22 Single Process Initiative Process [Ref. 68]

Mr. Scott Hyde, SPI coordinator for PMA-275, has mixed emotions over the results. An SPI is most likely approved if it is helpful to the contractor, provided the Government is not adversely affected. Contractors have been able to save time and cost and, in following, schedule and contract integrity are enhanced. Each SPI proposal has had little if any direct financial reward for the Government, however, as explained by Mr. Hyde.

This saves time and money...or it should. Time is definitely saved for the contractor as it is no longer jumping over one inspection into another. However, cost savings are not passed on to the Government. Each item found for SPI is labeled too insignificant an amount of savings to renegotiate the contract--a time consuming process. This means that the contractor saves, but the cost savings are not passed on.... [Ref. 69]

6. Use Performance Specifications and Non-Government Standards

The sixth guiding principle of acquisition reform is the use of performance specifications, elimination of detail specifications and, if possible, the use of non-Government standards. Those current specifications and standards that are practicable to change are being changed but the majority of the V-22's design work was done prior to the related June, 1994, Secretary Perry memorandum, and the program's use of them continues with a waiver.

Since Secretary Perry's memo, PMA-275 has included contract language to encourage contractors to respond with new innovative approaches. The new contracts for a full flight simulator (FFS) with Flight Safety International (FSI) and the production engine contract with Allison Engine Company are notable examples of this. The specifications drafted for the FFS were done envisioning a Federal Aviation

Administration (FAA) qualification process. The recent commercial item engine contract incorporating Power By The Hour® contractor logistic support, is built to MILPRF 937, a performance specification agreed to by Allison and PMA-275 because there was no comparable commercial equivalent. Detail specifications were scrubbed out of the program.

Many of the initial military specifications and standards are still appropriate for the V-22 aircraft. The majority of the aircraft's specifications and standards were set for the program more than a decade ago. Too much would be involved in switching them. Some may not have commercial equivalents. Those that are switched through the SPI process do not result in direct cost savings for the Government, as discussed in the previous section.

7. Issue Solicitations that Reflect the Quality of a World Class Buyer

From before the 1992 EMD solicitation, Secretary of the Navy O'Keefe had determined that Bell Boeing would be given an open opportunity to bring cost down and performance up. Stifling Government requirements and oversight had resulted in an average Government contract's costing 18 percent more than comparable commercial contracts. A painfully short "what, not how" solicitation was issued to Bell Boeing providing only the required performance parameters and the amount of funding available. With this solicitation, the Government started its effort toward being a "world class buyer." This effort has come to include: integration of oversight requirements with the contractor's program management scheme, coordination in advance to gain mutual

understanding of requirements and capabilities, and optimization of the use of electronic data interchange.

Integrating oversight responsibility goes hand-in-hand with the IPT structure, ITT focus and the military operational test team (MOTT) mission. All three integrate Government representatives with contractor representatives in an effort to provide timely oversight and feedback.

The V-22 program coordinates in advance with the contractors to eliminate confusion. Before the FFS RFP was released, representatives from the contractor and the Government met to establish just what would be required. This took place for the recent Allison engine contract, as well. The co-location of the contractors and Government was noted by those interviewed as extremely helpful in both processes.

The use of the computer to send and receive data is a blessing but the "paperless office" will only happen if humans are given better eyeballs or somehow the fatiguing process of scrolling through page after page on the computer screen is improved. The V-22 Deputy Program Manager raised doubts about the reported successes with paperless offices as she stated, "I challenge anyone to scroll through a 100 page technical paper on the computer." The system is able to get data to the office electronically, but when it is actually read, it is printed out first. [Ref. 64]

Data requirements in the program have been reduced from approximately 500 for EMD, of which 250 are transmitted electronically, to 83 for LRIP, of which 42 are

transmitted electronically. Though the EMD phase, by nature, requires more data requirements, the reduction is still noteworthy. [Ref. 72]

8. Procure Goods & Services with "Best Value" Techniques

The eighth guiding principle is to utilize "Best Value" techniques. This principle is all encompassing. To get the best value, one must take more into account than just the price. All of acquisition reform's guiding principles are relevant. If the V-22's price is low, but the aircraft breaks down too often, it has not been a good value. According to contractor and Government personnel interviewed, this has been common sense acquisition for some time. However, recent emphasis has enabled the program to lower life cycle costs with higher initial acquisition costs accepted by Congress.

A "Best Value" approach has been taken across the board but it is not always in line with CAIV. If the item is at or below a specification's cost/performance desired level but above the threshold, then a CAIV approach and "Best Value" approach are one and the same. However, if the item is above the specification's cost/performance requirement, even though it may be a "Best Value," it is considered "gold plating." This is illustrated in a diagram (Figure 4.6) Ms. Barbara Smith, PMA-275 Deputy Program Manager, used to explain the reason why, at times, the V-22 program can not use "Best Value."

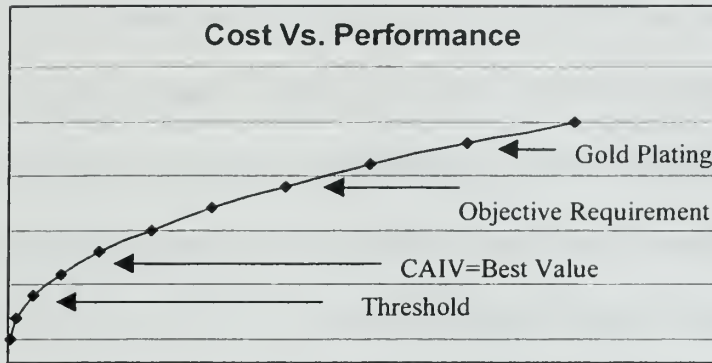


Figure 4.6, Best Value and CAIV [Ref. 64]

One issue, similar to a commercial industry's "marrying the supplier," is appropriate use of sole-sourcing. The lowest price is not always achieved, but contractor performance can be counted on. In the V-22 program, no one contested Bell Boeing for the production of the tiltrotor. By default, it was sole-source. Sole-source contract processing time, up until acquisition reform, depended on the amount of negotiation required and the levels of authorization required for approval. Acquisition reform has helped the V-22 program by eliminating this latter factor of bureaucracy. The V-22's Primary Contracting Officer (PCO), Roger Henry, told the author, "The best thing acquisition reform has done, is waive the sole-source reporting requirements, and delegate them from DoD to the commander of NAVAIR. This empowerment of the command speeds up the process tremendously." [Ref. 67]

9. Test & Inspect in the Least Obtrusive Manner to Add Value

Testing and inspecting, the ninth guiding principle, encourages building quality into the product up-front in order to minimize costly and often "no non-value added" end item testing later on. This initiative has had mixed returns with the V-22 program. Great

success in testing quality into the aircraft is achieved by the concurrent contractor/Government test and maintenance programs. Additionally, the increased use of commercial modeling technology significantly builds quality into the program. However, recent schedule pressure has resulted in poor deliverable quality and forced the Government to inspect each and every end item.

One area that the PM for the V-22 believes has greatly contributed to the success of the program is the integrated test team (ITT) and maintenance operational test team (MOTT). Early on, both the contractors and the Government insisted that testers/evaluators be value-added team participants from the start, not inspectors after-the-fact. This has eliminated a great deal of duplicative testing. The program has reduced the test time required 72 percent from 5 months to 6 weeks. Each flight that goes up has a military test pilot and a commercial test pilot. Contractor testing is fully optimized. Likewise, both contractor and Government maintainers complete each maintenance action that takes place. The inclusion of the user has increased "ownership" of the aircraft's developmental successes and failures by all testers and maintainers. If anything goes wrong, both the Government and contractors have ownership of the problem and "finger-pointing" does not take place. Likewise, successes are truly recognized as the V-22 team's and not jealously regarded by any of the testers and maintainers.

Another successful initiative is the use of computer aided design, computer aided manufacturing and computer aided engineering (CAD/CAM/CAE). This use of modeling and advanced simulation, as described in section five, saves time and reduces cost. By using a virtual component, expensive physical models are not required.

The program would like to achieve quality with statistical process control (SPC) rather than with end item inspection, but there have been two issues which prohibit this from occurring. First, there are not enough items produced, as of yet, to achieve a valid population from which to derive normalcy information, which is required to conduct statistical process control. As more aircraft are produced, SPC may be feasible. Second, and more disturbing, Bell Boeing is currently behind schedule with certain deliverables, and the rush to expedite them has decreased their overall quality. Aircraft arrive at Patuxent River Naval Air Station having been "thrown together" just to meet schedule. Additionally, aircraft arrive without having recent design modifications incorporated [Ref. 63]. This only slows the program even further and increases the pressure to "rush" at the expense of quality. Though the Government had initially planned on inspecting one of five or one of ten deliverable items in a lot, defect rates compel inspection of each and every item. [Ref. 73]

10. Manage Contracts for End Results

Managing contracts for end results requires contracting with a performance specification to allow freedom for design innovation, focusing on the customer and the

service required. Technical data rights/package (TDR/P) is acquired only to the extent necessary.

Since the acquisition for the V-22 has been sole-source, the freedom for design has been provided by simple paragraphs in solicitations that, essentially, provide the contractor the opportunity to respond with innovation.

By focusing on the customer, PMA-275 has been able to recognize which performance requirements are "hard" and which are not. One example would be the need for the V-22 to achieve 345 knots. The V-22 can achieve 343 knots. Does the user consider this critical? In a CH-46E today it may be impossible to differentiate two knots of airspeed because the aircraft shakes so much. PMA-275 chose to fight for the program instead of acquiescing and switching to another helicopter. The user needs the capabilities of the V-22. Always being mindful of the needs of the user compelled the program to bring Marine and Air Force maintainers into the program early to provide input and, later, have a user knowledge base in place when the program reaches IOC in 2001.

The latter of these two, the knowledge base, is a current area of concern with those in the program. The knowledge base may not fully materialize unless Marine Manpower can figure a way to waive overseas control date requirements for V-22 maintainers. A recent control date is required for promotion for all Marines—including aviation mechanics. The problem is that there are no V-22 units overseas for these Marine mechanics to support and their serving in another capacity reduces their V-22

proficiency. While sharing hardship and time away from families is noble and fair, the Marine Corps might be better served if these few Marines were not given an opportunity to lose perishable skills. Moreover, these experienced maintainers are prime targets for Bell and Boeing. As a maintainer finishing up three years with the V-22 MOTT, the choices are either to go overseas (perhaps away from family) in order to get promoted and stay in the Marine Corps, or to join the lucrative civilian tiltrotor effort and stay with family. Both options drain the knowledge base required for the program to kick off in 2001. [Ref. 74]

The most recent commercial contract with Allison illustrates just how to contract for a system's technical data rights/package to satisfy both the Government's and contractor's interests. The two important issues are 1) the rights to produce a system and 2) the package, itself, containing the technical information with which to do this. The technical data rights for the commercially developed AE-1107C engine was a sticking point in recent negotiations until a "win-win" compromise was reached.

Ownership of technical data rights is dependent on to what degree an item/process is developed with Government funding. The more a contractor develops an item/process, the more it is proprietary in nature. The whole collection of items/processes makes up a technical data package. It is possible that the Government could have a technical data package and not be able to do anything with it because it did not have required rights to the item/process.

Both Allison and the Government need data rights. Allison was willing to forfeit the contract to retain the technical data rights to the AE-1107C engine. With full data rights, the Government, if it so desired, could approach a competitor, like General Electric, and ask it to use the rights to build the engines for the Government. While General Electric had possession of the rights, it could legally produce the engines for the commercial market as well. This, obviously, would not benefit Allison, who anticipates selling approximately 14,000 similar engines to the commercial market. [Ref. 64]

The Government required the data rights to ensure future engine producibility should Allison, for any reason, not be capable of producing the engine. The PCO devised a plan for the Government to retain the technical data rights and package with the stipulation that the rights would be leased to Allison for the life of the contract. This protected Allison from a potential competitor's use of the engine.

One further concern the Government had was that Allison might "buy in" with this contract only to increase support costs in the following contract, roughly seven years from now. Moreover, Allison might refuse to produce the engine for the Government entirely, requiring the Government to ramp up another company at great cost. To ensure these events did not happen, the PCO included language ensuring \$200 per ESMH in perpetuity at constant FY-1997 dollars and the shifting of "Government use only" data rights to the Government. Should Allison pull out of the contract, use of the data rights to supply more lucrative customers would be prohibited. [Ref. 64]

The addition of acquisition reform initiatives in the V-22 program's toolbox has helped the program accomplish some "value added" results. The business process of the program has shifted radically. No longer is the chain of command viewed as a constraint but is now seen as an enabling mechanism. An application of acquisition reform guiding principles to the V-22 program reveals that this new way of doing business can bring substantial return, even for an ongoing program. It also reveals that more can be accomplished. The next subchapter provides a brief look at the program's "joint" aspect.

C. V-22 PROGRAM "JOINT" OBSERVATIONS

Since the initial JSOR, personnel from different services have worked side by side to acquire leap-ahead vertical lift technology. Deputy Program Manager, Barbara Smith, recognized numerous contributions that the Air Force members of the program had made over the years. The up-front maintenance and test team integration and IETMs are just a couple examples. The current coordination of the different acquisition personnel and cultures in this venture are the subject of this brief subchapter. First, the position of the CV-22 project manager is examined. Next, the cultural strengths and weaknesses of the different services are discussed.

Though initially "joint," the V-22 program is officially not "joint." According to the defense acquisition deskbook (DAD), "joint" applies to a program that receives funding from at least two separate Services. The lead Service, the Navy, is funding all current RDT&E efforts. The Air Force will fund only procurement of its CV-22 aircraft—in accordance with the 1994 ADM guidance. However, procurement refit of

aircraft number nine will occur in FY-1999--just around the corner. Once this occurs, the nature of the program may change to become, once again, truly "joint."

The office structure and interaction reflect the unique status of the program.. Though all Air Force personnel interviewed enthusiastically commented on the degree of consideration the program's Marine PM showed for Air Force needs, they were also quick to point out that the V-22 is not a "joint program" but "multi-Service." If it were joint, they would have great deal more input as to how the program is run. With no funding in the program, as of yet, the Air Force relies on the good will of the Navy and Marine Corps. To enhance the Air Force influence on the program, the Air Force maintains clout by positioning an experienced Colonel in the CV-22 project manager position. The Marine equivalent project manager is a Lieutenant Colonel. Additional benefits from this "heavy hitter" in the program relate more within the Air Force itself. Two other Program Executive Officers (PEOs) within the Air Force have interest in the V-22 program. One, representing the USAF, is a Brigadier General, and the other, representing the AFSOC, is a Colonel. The CV-22 Project Manager must report to not only the V-22 PM and PEO, but, unofficially, to these two Air Force officers as well. [Ref. 75]

There is a cultural difference between the Air Force and the Navy. The Air Force, by nature is more directive. Having been spawned in the early nuclear weapons race when strict accountability was essential, operational decisions have rested with senior officers. The Navy, by the nature of command at sea, has empowered its officers to take initiative, once given broad guidance. This cultural difference is evident, as well, in the

responsibility given respective pilots. Air Force pilots may not sign their operational flight plans. This is done by their unit's operations department. All Navy and Marine pilots have this authority to sign their own flight plans. The cultural differences between the services reflect upon their views on acquisition reform.

In discussing the reform accomplishments between the services, MAJ Legge, Assistant Project Manager for the CV-22 (SOCOM version of the V-22), noted both strengths and weaknesses in each culture. The directive nature of the Air force produced the "375 series" from which the present acquisition system is derived. However, in the Air Force, this direction translates into a lot of "non value added" work. One brief after another is given to assure the leadership that a program is complying with acquisition guidance. The acquisition reform "lightening bolts" are solid tools, but they must be tailored to a program and not just be given lip-service. Pressure to sound and look good is strong. The bureaucracy is alive and well. In the Navy, the culture allows a great deal of initiative to be taken by the PM. Though the program may feel it gives too many briefs and that they are too structured, the briefs are far less so than equivalent Air Force requirements. Whereas the V-22 program uses one or two slides in briefing acquisition reform, the Air force uses eleven. The Air Force requires much more paperwork. The strength the Navy has in this area can be a weakness as well. In the Navy culture, because there is less oversight, a program is only as capable its empowered officers. If someone is empowered who does not possess the requisite skills or experience, a program may not recover.

The makeup and training for those in a program office is different as well. Though PMA-275 has 72 of the 74 personnel attached to the program level two or level three DAWIA certified, only a handful of them are trained in program management. They are senior officers. In Air Force programs, numerous junior officers, trained in program management, assist in the management of the program. In the Navy, though many supporting personnel are co-located in the office itself, others are matrixed program members of other offices and commands. The Air Force includes everyone in the office. Co-location is very important. The office is more like a command, in and of itself, with the PM acting as a Commanding Officer.

Overall, the services differ in their approaches, but are working well together at PMA-275. The best of both cultures has emerged and should serve as an exemplar for future “joint” and “multi-service” acquisition.

D. CONTRACTOR INPUT

Response from contractor personnel toward acquisition reform is extremely positive. Many contractors, having been in the military themselves at one time or another, are excited that Marines and Airmen are receiving a quality product and they give credit to the initiatives of acquisition reform. The only negative aspect mentioned is that it has not occurred earlier and that it has not gone far enough. According to Bruce Potocki of Boeing, “There are still many statutory and regulatory changes that need to be made to eliminate Government mandates that conflict with commercial practices and processes.” Mr. Potocki, winner of the DSMC Acquisition Research Symposium “David

D. Acker” award, recommends a change of the International Traffic in Arms Regulations (ITAR) to accommodate dual use production lines. Norbert Josten of Boeing recommended that the “core requirements” restriction on depot support be re-examined. These laws, he feels, are a result of the old paradigm that only the depot could be relied upon to spool up for war. With today’s technology and laws to support military industry, Boeing, Bell, Allison and any other contractor can be relied upon, in time of national emergency, to provide support similar to military depots.

E. CONCLUSION

This chapter has examined what acquisition reform measures are in place with the V-22 program and the effect they have had, the cultures of the services at PMA-275, and the views of some of the contract personnel. A transformation of the business process from the top-down has enabled the program office and its prime contractors to optimize cost, schedule and performance innovatively. Earned value management metrics are actively incorporated into the program’s risk management process. Cross-functional IPTs, as the backbone of the program, break down “stove pipes” and facilitate concurrent engineering. The program looks at the overall cost of ownership and has successfully implemented initiatives like CAIV and CLS. Funding instability continues to haunt the program due to annual shifting of acquisition funds to contingency O&S funds.

Commercial products and processes, from massive CATIA graphite fiber placement machines to IETMs return the most quality for the program dollar. Though many of the MILSPECS and standards remain from the pre-reform development phases, those that

can be removed or deleted prudently have been. Commercial item acquisition of the AE-1107C is a case study of how to effectively use acquisition reform to minimize O&S costs. “Best Value,” within a budget, is sought in all decisions. Savvy “win-win” contracting has ensured an end result that saves 30 percent in support costs and incentivizes improved reliability.

Cultures within the Navy and Air Force have both strengths and weaknesses. These strengths and weaknesses impact how the two Services act on acquisition reform initiatives. In the V-22 program, the Services' cultures have complimented each other.

Much is being accomplished with acquisition reform in the V-22 program and DoD. However, There are still statutory and regulatory changes that commercial industry believes are needed to achieve further reform. The “core” weapons restrictions and ITAR are two examples of regulations that should be addressed in future reform efforts. Further conclusions and recommendations are presented in Chapter V.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This thesis provides background information on the once-cancelled V-22 program and acquisition reform and then examines the impact of the latter on the former. It analyzes the V-22 program using DoD's "ten guiding principles of acquisition reform" as a standard and concludes that acquisition reform is having mixed results on this Major Defense Acquisition Program.

Much is being accomplished with acquisition reform in the V-22 program. A transformation of the business process from the top down is enabling the program office and its prime contractors to optimize cost, schedule and performance innovatively. Earned value management metrics are actively being incorporated into the program's risk management process. Concurrent contractor/Government testing and maintenance reduces test time required by 72 percent. Cross-functional IPTs, as the backbone of the program, are breaking down "stove pipes" and facilitating concurrent engineering. Successfully implementing initiatives like CAIV and CLS are reducing total ownership cost of the program--cradle to grave. Commercial products and processes, like the Allison AE-1107C engine and CATIA software, are providing high quality systems at market controlled prices. Commercial item acquisition and CLS are being used effectively to minimize life cycle costs. "Win-Win" contracting with industry is providing engines whose reliability should actually improve with time and reduce support costs by over 30 percent.

Much remains to be accomplished. Funding instability continues to haunt the V-22 program due to frequent re-programming of DoD acquisition funds to contingency O&S funding. SPI, a primary vehicle intended to usher acquisition reform into ongoing contracts, benefits contractors but has failed, at least initially, to return any direct savings to the program office. Finally, contractor input suggests that core requirements and ITAR should be revamped to take advantage of industrial capacity and streamlined methods. However, Congress has constrained DoD decisions on core versus CLS.

B. RECOMMENDATIONS

IPTs, CLS, EVM, commercial products and processes, “what, not how,” solicitation, performance specifications, commercial item acquisition and CAIV are “value added” tools to the V-22 program that should achieve beneficial results in other acquisitions as well.

Acquisition reform opens numerous opportunities for learning organizations to benefit. Both Government and contractor organizations should continue to seek ways to improve upon the acquisition process.

Realistic contingency funding should be included in fiscal budgets to mitigate risk from unforeseen obstacles. A recent \$3 billion contingency bill that is separate from budgeted DoD funding is one possible method. This approach could avoid very costly disruption that occurs when acquisition program funding must be decremented.

The SPI should be altered to pass a proportion of any program-related savings back to the program office. With no direct benefit from SPI and the effort required to track it, program offices get "no value added" from the initiative, as it stands.

C. ANSWERS TO RESEARCH QUESTIONS

1. What are the effects of acquisition reform on PMA-275, Bell Boeing, and Allison in the execution and delivery of the V-22 Osprey?

The effects of acquisition reform on PMA-275, Bell Boeing and Allison are summarized in the conclusion section of this chapter and are covered in detail in Chapter IV. Overall effect of acquisition reform on PM V-22 and each of the prime contractors has been a more efficient process.

2. What are the background and history of the V-22 Osprey program?

The history of the V-22 program is addressed in some detail in Chapter II.

3. What are the principles of acquisition reform and why are they important?

Ms. Colleen Preston, former Deputy Under Secretary of Defense (Acquisition Reform), summarized what acquisition reform is and what it is intended to achieve in her "Ten Guiding Principles of Acquisition Reform." The researcher gauged the V-22 Osprey program by comparing it to each of her ten principles:

1. Empower People to Manage--Not Avoid Risk
2. Operate in Integrated Product Teams
3. Reduce cycle Time by 50 Percent
4. Reduce Cost of Ownership

5. Expand use of Commercial Products and Processes
6. Use Performance SPECs and NON-Government Standards
7. Issue Solicitations that Reflect the Quality of a World Class Buyer
8. Procure Goods & Services with "Best Value" Techniques
9. Test & Inspect in the Least Obtrusive Manner to Add Value to the Process or Product
10. Manage Contracts for End Results [Ref. 50]

4. How have PMA-275 and the contractors applied acquisition reform to the V-22 Osprey program?

PMA-275 and the contractors have applied acquisition reform in a number of ways. As this is pivotal to the primary research question, this chapter's conclusion section summarizes the ways PMA-275 and the contractors have applied acquisition reform and the effect this reform has had. Chapter IV analyzes the program's use of acquisition reform, in greater depth, against the "guiding principles of acquisition reform."

5. How are the effects of acquisition reform measured in the V-22 Osprey program?

The effects of acquisition reform are measured by earned value management system (EVMS) metrics to track the progress and cost of the program. Pertinent cost and schedule data are gathered and analyzed in each of the 74 IPTs. This is covered in greater detail in Chapter IV.

6. What are the future implications of acquisition reform on the V-22 Osprey program?

Acquisition reform has been the vehicle for numerous improvements in program cost, schedule, and performance, and will continue in this vein in the future. As OPEVAL, MS III and IOC draw near, acquisition reform will free PMA-275 to be “the smartest, most responsive buyer, of the best goods and services, that meet the of the warfighter’s needs, at the best value over the life of the product.” This is covered in greater detail in Chapter IV. [Ref. 69]

D. SUGGESTIONS FOR FURTHER RESEARCH

The research for this thesis revealed other areas that if studied, could benefit the Government and DoD. The following paragraphs discuss these areas:

1. But for the efforts of a handful of Congressmen, the V-22 could very easily have been politically wounded and have would never have recovered. An in-depth study of the costs and benefits of political influence on military systems acquisition could reveal opportunities to enhance or re-engineer the process to optimize system utility.

2. Current acquisition reform principles have been value added. An in-depth analysis of why this recent effort succeeded and other efforts in the past failed should be conducted. Process re-engineering models, similar to IDEF, or process change models, similar to that devised by Richard Bechard, could outline required elements for successful process change. Causal organizational issues within DoD should be addressed so that beneficial change can occur in the future.

3. O&S contingency reprogramming causes instability in acquisition programs. Starting in FY-2000 DoD will have a reserve available for acquisition executives to stabilize programs, but this reserve specifically excludes funding for contingency induced instability. It will only stabilize programs affected by “technical risk.” Research into how to create a new O&S contingency fund would benefit all acquisition programs.

4. The single process initiative (SPI) may not be accomplishing what it was designed to. How should the single process initiative be altered to reduce acquisition cost to the Government? An examination of the incentives that are present and how these incentives should be restructured to fix SPI would provide a vehicle for DoD to realize intended savings.

LIST OF REFERENCES

1. U. S. Congress, "Civil Tiltrotor Applications Research," Hearing Before the Subcommittee on Transportation, Aviation and Materials, of The Committee on Science, Space and Technology, U. S. House of Representatives, 17 July 1990.
2. Schneider, J. J., Rotary Wing V/STOVL: Development Of The Tiltrotor, *The Age of The Helicopter: Vertical Flight*, Smithsonian Institution Press, Washington, D. C., 1984.
3. Campbell, J. P., *Vertical Takeoff and Landing Aircraft*, The Macmillan Company, New York, 1962.
4. "Tiltrotor - A Brief History," Bell Helicopter Major Events, *Aeronautical Awards for Tiltrotor Development*, Bell Helicopter Textron Interoffice Memorandum, 11 September 1991.
5. "Tiltrotor Development - A 40 year Investment," Internet Site <http://www.boeing.com/rotorcraft/military/v22/1687-a4.html>
6. "History of Tiltrotor Technology," Internet Site <http://www.simlabs.arc.nasa.gov/Do...ive/tiltrotor/ctr20th.html#History>
7. Lundberg, Dar, Bell Boeing Program Office, Arlington, Virginia, Telephone interview with the author, 14 January 1998.
8. "V-22 Significant Events," (PMA-275C3:MLR, 6 February 1997), Briefing template from interview with Mary Lou Ragan, 23 January 1998.
9. Smith, Barbara, PMA-275 Deputy Program Manager, Interview with the author, Patuxent River Naval Air Station, Maryland, 19 December 1997.
10. "The Case For The V-22 Osprey Program," undated Bell Boeing publication.
11. Interview between Dean Sedivy and Dick Ballard, Ballard Associates, and Jim Davis, Teldyne Continental Motors, Washington D.C., 14 November 1991 found in Sedivy, Dean G., *Beurocracies At War: The V-22 Osprey Program*, Executive Research Project F 37, The Industrial College of the Armed Forces, 1992.

12. Lehman, John F. Jr., *Command of the Seas*, C. Scribner's Sons, New York, 1988.
13. Dean, Scott D. and Schemmer, Benjamin F., "Industry Risks billions on LHX, New Fighters, and Aerospace Plane," *Armed Forces Journal International*, June 1988, p. 50.
14. Mecham, Michael. "Contractors Press Congress to rewrite Defense Reforms," *Aviation and Space Technology*, 11 April 1988, pp. 14-16.
15. "Transportation Congestion: The Tiltrotor Solution," Bell Boeing Release TR-1(06-10-90), 10 June 1990.
16. "V-22 Technology Transfer," Bell Boeing Release TT-1(07-03-90), 3 July 1990.
17. Untitled chronology of Events, PMA-275B (histdale) 26 March 1996, from interview with Mary Lou Ragan, Patuxent River Naval Air Station, Maryland, 23 January 1998.
18. Spivey, Dick, Bell Helicopter Textron, Telephone interview with the author, 2 February 1998.
19. Fessler, Pamela. "Cheney's Spending Blueprint Faces Welter of Changes," *Congressional Quarterly Weekly Report*, 3 February 1990, pp. 333-339.
20. Department of Defense, *Inspector General Audit report: Acquisition Of The V-22 Joint Services Advanced Vertical Lift Aircraft (Osprey)*, no. 89-077, 14 June 1989.
21. O'Brien, Mark A., *The V-22 Osprey: A Case Analysis*, Master's Thesis, Naval Postgraduate School, Monterey, CA, June 1992.
22. U. S. Congress, *Institute For Defense Analysis Study of The V-22 Osprey*, Hearing before a subcommittee of the Committee on Appropriations, United States Senate, 19 July 1990.
23. Hetzer, Robert. "Marines Scramble to Replace Cancelled V-22," *Defense News*, 26 February 1990.
24. "The Dream," Bell Boeing marketing video of the history of the V-22, undated.
25. "Lateral Control Problems Figured In V-22 Crash," *Aerospace Daily*, 18 June 1991.

26. Civil Tiltrotor Development Advisory Committee (CTRDAC), Report to Congress, December 1995.
27. U. S. Congress, *The Status Of the V-22 Aircraft Program*, Hearing before the Procurement and Military Nuclear Systems Subcommittee and the Research and Development Subcommittee, of the Committee on Armed Services, House of Representatives, 5 August 1992.
28. U. S. General Accounting Office Report to the Chairman, Committee on Armed Services, House of Representatives, *Navy Aviation, V-22 Development- Schedule Extended, Performance Reduced, and Costs Increased*, 13 January 1994.
29. Clark, Ross, Boeing MV-22 Program Director, Interview with the author, The Boeing Company, Philadelphia, Pennsylvania, 17 January 1998.
30. "NTSB Says Loose Bolt Caused XV-15 Crash," *Aviation Week and Space Technology*, 31 August 1992, p. 26.
31. "Bell Boeing Team Gets Navy Contract To Aid In V-22 Crash Investigation," *Aerospace Daily*, 20 August 1992.
32. Source identification withheld on non-attribution agreement.
33. "Osprey Will Test Acquisition Reform," *Defense News*, 12 September 1994.
34. "V-22 May Test Acquisition Reform," *Defense News*, 4 October 1993.
35. "Bell Boeing Say V-22 Could Be One Third Cheaper," *Aerospace Daily*, 2 October 1992.
36. Bob Caresse, Bell Textron Customer Requirements Office, Telephone interview with the author, 10 February 1998.
37. "Osprey Fax," Bell Boeing Tiltrotor Team Publication, Volume 8, Issue 2, 17 October 1997.
38. U. S. General Accounting Office report to the Chairman, Committee on Armed Services, House of Representatives, *Navy Aviation: V-22 Cost and capability to meet requirements are yet to be determined*, October 1997.

39. "Memorandum For The Defense Acquisition Community, Update of the DOD 5000 Documents, Executive Summary," 15 March 1996.
40. U. S. General Accounting Office, *Weapon's Acquisition: A Rare Opportunity for Lasting Change*, December 1992.
41. Holley, Irving R., *Buying Aircraft: Material Procurement for the Army Air Force*, Office of the Chief of Military History, Washington, D. C., 1964.
42. Department of Defense Acquisition Reform Acceleration Day, "Acquisition Reform Legislation," Executive Summary, 31 May 1996.
43. "FY-1996 Defense Authorization Act Hailed As Victory For Acquisition Reform," 1 February 1996 DOD Press Release," Internet Address:
<http://www.dtic.dla.mil/defenseink/>
44. Cuff, Robert D., *The War Industries Board*, Johns Hopkins University Press, Baltimore, Maryland, 1973.
45. Acker, David C., *Acquiring Defense Systems, A Quest for the Best*, Defense Systems Management College Press Technical Report 1-93, Fort Belvoir, Virginia, July 1993.
46. "Final Report of the Acquisition Reform Benchmarking Group to the Under Secretary of Defense (Acquisition & Technology)," 30 June, 1997.
47. "Memorandum for the Defense Acquisition Community; Update of the DoD 5000 Documents," Office of the Secretary of Defense, 15 March 1996.
48. "A Brief History of the National Performance Review," Internet address
<http://www.npr.gov/library/pcpns/bkgrd/brief.html>
49. "Department of Defense, William J. Perry," Internet address
<http://www.npr.gov/library/nprpt/annrpt/vp-rpt-96/appendix/dod.html>

50. "Ten Guiding Principles of Acquisition Reform," Internet address <http://www.acq-ref.navy.mil/princ.html>
51. President's Blue Ribbon Commission on Defense Management, *A Quest for Excellence: Final Report by The President's Commission on Defense Management*, Government Printing Office, Washington D. C., 1986.
52. Gregory, Linda J., The Role of Configuration Management in the Acquisition Process," *National Contract Management Journal*, Vol. 26, No.1, 1995.
53. Pegnato, Dr. Joseph A., "Procureosclerosis," *National Contract Management Journal*, Vol. 26, No.2, 1995.
54. "Discussion of the Acquisition Workforce Improvement Act," Internet address <http://www.dtic.mil/acqed2/legislation/dawiadis.html#1>
55. U. S. Congress, "Acquisition Policy Reform," Hearing before the Military Acquisition Subcommittee of the Committee on Armed Services, of the House of Representatives, 10 March 1994.
56. Carlucci, F.C., III, "Improving the Acquisition Process," Memorandum for Secretaries for the Military Departments, Chairman of the Joint Chiefs of Staff, Under Secretaries of Defense, Assistant Secretaries of Defense, General Counsel, Assistant to the Secretary of Defense, the Deputy Secretary of Defense, Washington D. C., 30 April 1981.
57. Whitworth, Lloyd R., *Software Risk Management: A Case Study of the V-22 Program*, Master's Thesis, Naval Postgraduate School, Monterey, CA, June 1992.
58. "V-22 IPT Government Participation Concept of Operations", PMA-275 inter-office memorandum, 2 July 1993.
59. V-22 IPT Organizational Chart, Given to the researcher by Mr. Norb Josten, Boeing Vertol, Philadelphia, Pennsylvania, 22 January 1998.

60. "Recommendations," Overhead chart presented to Under Secretary Paul G. Kaminski by Bell Textron, Washington, D. C., 01 October 1996.
61. Nissen, Mark E., Dr., IDEF Model for Business Process Modeling, Acquisition of Embedded Software class discussion, 12 July, 1997.
62. Smith, Barbara, PMA-275 Deputy Program Manager, Interview with the author, Patuxent River Naval Air Station, Maryland, 22 January 1998.
63. Buyers, John, Program Director, Joint Program Office, Bell Helicopter Textron, "ITT Weekly Progress," e-mailed to the author, 9 March 1998.
64. Hyde, Timothy, Maj. USMC, V-22 Logistics Support Director, Interview with the author, Monterey, California, 10 March 1998.
65. Schmidt, Nolan, PMA-275 Program Manager, Interview with the author, Patuxent River Naval Air Station, Maryland, 22 December 1997.
66. Harrison, Dana, PMA-275 Financial Analyst, Telephone interview with the author, 10 March 1998.
67. Henry, Roger, V-22 Primary Contracting officer, Interview with the author, Naval Air Systems Command, Patuxent River Naval Air Station, Maryland, 22 December 1997.
68. "Navy Success Stories: V-22 Osprey Program Team," Internet address <http://www.acq-ref.navy.mil/V-221.html>
69. Richbourg, Donna S., Acting Deputy Under Secretary of Defense for Acquisition Reform, "Staggering plights, Reforming the Defense Department Acquisition Collosus," *Veteran's Vision*, Volume IV, Number 1.
70. King, C. G., "Multi-Discipline Teams: A fundamental Element of the Program management Process," *PM Network*, Defense and Space group, The Boeing Company, Seattle, Washington, August 1992.
71. "V-22 CAIV Program Implimentation Plan," Telefaxed draft copy from CDR Ahern, PMA-275 Business Financial Manager, 15 February, 1998.
72. Jansen, Marty, PMA-275, Telephone interview with the author, 10 March 1998.

73. Ricker, Timothy, Major, USMC, PMA-275 Avionics Logistics, Interview with the author, Monterey, California, 10 March 1998.
74. Lozano, Donald, SSGT, USMC, V-22 Military Operational Test Team, Interview with the author, Patuxent River Naval Air Station, Maryland, 22 December, 1997.
75. Legge, D., PMA-275 CV-22 Assistant Project Manager, Interview with the author, Patuxent River Naval Air Station, Maryland, 22 December 1997.

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